60p

YOUR COMPUTER

JANUARY 1982

Vol.2 No.1

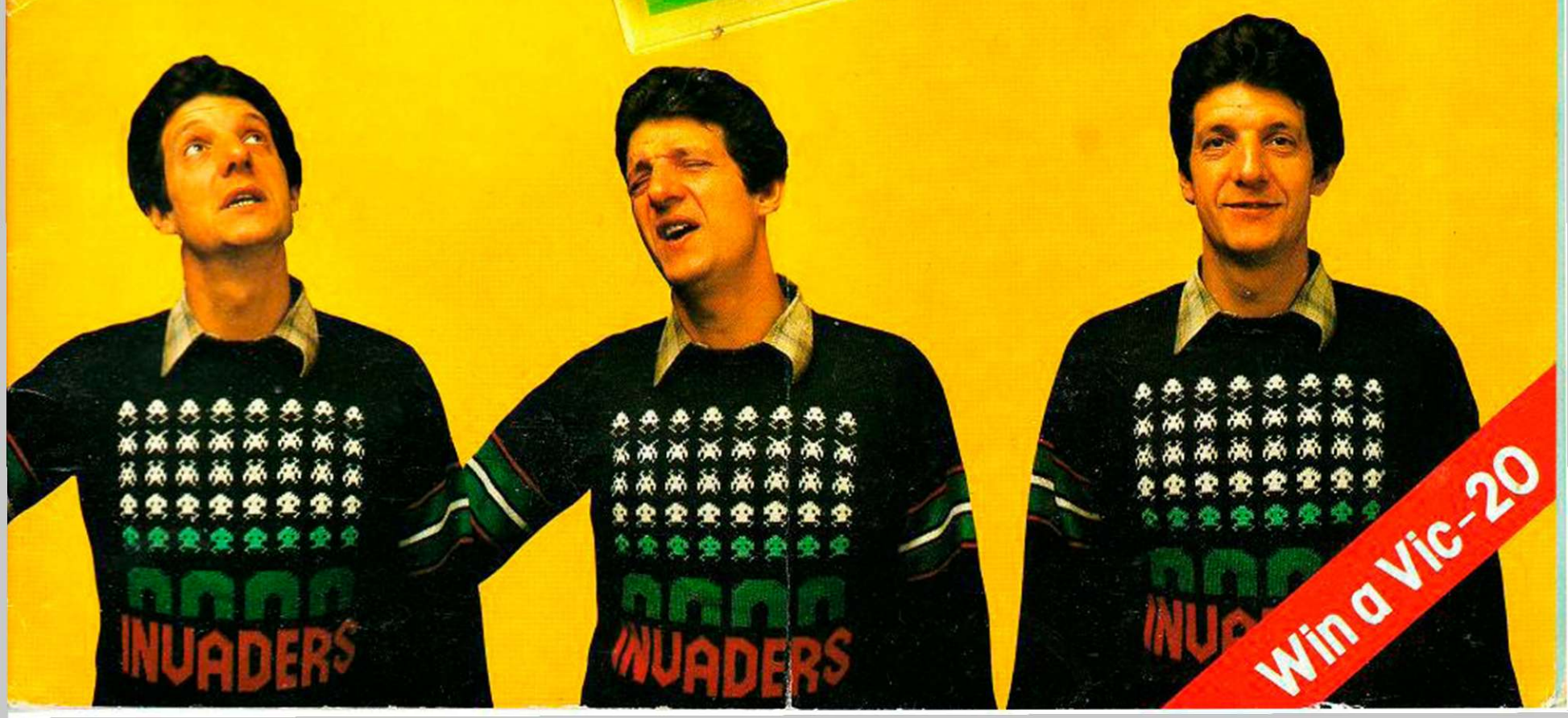
We look inside the BBC micro

Review: Atom word processor

New chess machines

Sinclairs in schools

Fast ZX-81 graphics



Win a Vic-20

ingenious!

..that's the only word to really describe the superb Genie microcomputer system, the home computer which is compatible with the TRS 80, and ideal for all micro - enthusiasts, especially the committed hobbyist.
Genie has now been upgraded to Genie I, incorporating all of the original, excellent features, but with the addition of:

- Extended BASIC, including RENUMBER and SCREEN PRINT.
- Full upper and lower case, flashing cursor and auto-repeat on all keys.
- An internal SOUND UNIT to add a new dimension to your own programs.
- A MACHINE LANGUAGE MONITOR, with Display, modify, enter and execute (with break points) facilities.

Genie I has all of this, plus the built-in cassette deck, 16K RAM, 12k ROM with BASIC interpreter, full-size keyboard , an extremely wide range of new and up-dated peripherals, and literally 1000's of pre-recorded programmes available. Yet, almost unbelievably, the price of Genie I is even lower than that of the original Genie.

Ingenious for business

The Genie II is a major breakthrough for small business computers. Harnessing all the advantages of Genie I, including low price, Genie II adapts perfectly to commercial functions with the following features:

- Numeric keyboard
- Four usable, definable function keys.
- Extension to BASIC
- Basic business commands
- Fully expandable with the same peripherals

New!...12" Monitor

Now, a choice of 2 monitors giving a clear easy to read image. The updated EG101 has a new green phospher tube.

New!...Expander

An updated Expansion Box (EG 3014) is a major feature of the new Genie I system, and unleashes all its possibilities, allowing for up to 4 disk drives with optional double density. It connects to a printer, or RS232 interface or S100 cards. There is 16k RAM fitted and it has a new low price!

New!...Printer

The EG 602 printer can be connected to the Genie either through the expander or directly into the computer using the Parallel Printer Interface. It is a compact unit, with an 80 column, 5 x 7 matrix print-out, operating quietly and efficiently at 30 characters per second.

Disk Drive

As well as the obvious advantage of mass storage, the addition of the disk system to the Genie means much faster access to other languages and full random access file handling. Up to 4 of these 40 track drives can be used on a system.

SPECIAL TECHNICAL GENIE HOT - LINE ON 0629 4995

for all your technical advice and service back-up on any aspect of the Genie system direct from the experts!

For full details and demonstration of Genie I, Genie II or advice on any aspect of the system, either call in to your local dealer, or write directly to the sole importers at the address below.

LOWE electronics

Chesterfield Road, Matlock, Derbyshire DE4 5LE.
Telephone: 0629 4995. Telex: 377482 Lowlec G.

YOUR COMPUTER

YOUR LETTERS: 11
Do not blame the teachers if girls do not compute; ZX-81 Repeat-Until routine.

NEWS: 12
£1,000 prize for first ZX-81 Prestel adaptor, Vic-20 transformers recalled, sound boards.

COMPUTER CLUB: 15
David Pollard visits the Microcomputer Club in Croydon, south London, and talks to its founder, Vernon Gifford.

BBC MICROCOMPUTER: 16
Tim Hartnell tests the newly-launched BBC Microcomputer and likes what he finds.

ATOM WORD PROCESSOR: 18
Norman Kirkby reviews the Atom WordPack ROM with the Seikosha GP-80 printer.

INTERVIEW: 24
Duncan Scot talks to Kenneth Baker, Minister of State for Industry and Information Technology, about the Government's plans for promoting the use of personal computers.

CHESS SURVEY: 26
Two new advanced chess computers have arrived on the British market. John White evaluates the Morphy module and the Challenger Sensory Champion.

GAME: 30
Treasure House — an adventure-style game for the Sharp MZ-80K.

EDUCATION: 35
Eric Deeson presents some ZX-81 programs for use in the classroom.

VIC-20 SOFTWARE: 38
Get to grips with those pattern- and music-generating programs on your Vic-20.

BASICS OF MACHINE CODE: 40
Still baffled by machine code? This article starts at the beginning.

ZX-81 GRAPHICS: 48
Fast-moving graphics on the ZX-81 need some advanced programming. We reveal a selection of subroutines which can be used to develop a fast game of Breakout.

COMPUTER CONTROL: 52
John Dawson continues his series by investigating the conversion of analogue signals to digital form.

FINGERTIPS: 57
David Pringle presents more thoughts on programming calculators and selects some readers' programs.

RESPONSE FRAME: 59
Answers to your technical queries.

SOFTWARE FILE: 61
Eight pages of your programs.

COMPETITION: 73
Another puzzle with a £15 book token as prize, the solution to the November Trolls' Cave puzzle and the Tantel adaptor crossword. The Vic-20 crossword falls between pages 10 and 11.

Cover photographs of Chris Serle and the BBC Microcomputer by Stephen Oliver. Our thanks go to Stone & Son, Upper Richmond Road, London SW15, for the loan of the Space Invaders pullover.

Editor
DUNCAN SCOT

Assistant Editor
BRENDON GORE

Staff Writer
BILL BENNETT

Production Editor
TOBY WOLPE

Production Assistant
JOHN LIEBMANN

Editorial Secretary
LYNN COWLING

Editorial: 01-661 3500

Advertisement Manager
DAVID LAKE 01-661 3021

Assistant Advertisement Manager
PHILIP KIRBY 01-661 3127

Advertisement Executives
KEN WALFORD 01-661 3139
BILL ARDLEY 01-661 3127

Midlands Office
DAVID HARVETT 021-356 4838

Northern Office
RON SOUTHALL 061-872 8861

Advertisement Secretary
MANDY MORLEY

Publishing Director
CHRIS HIPWELL

Your Computer, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.
Typesetting by In-Step Ltd, London EC1.
Printed by Riverside Press Ltd, Whitstable, Kent.
Subscriptions: U.K. £8 for 12 issues.

Published by IPC Electrical-Electronic Press Ltd, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS. Tel: 01-661 3500 Telex/grams: 892084 BIPRESG.

EDITORIAL

1982 IS INFORMATION Technology Year. During the year the Government hopes to ram home the message to the British public that if we want to see our living standards rise or, less optimistically, if we want to slow up the decline, we will all have to embrace new technology in our business and private lives. In an interview on page 24 Kenneth Baker, the Government Minister responsible for IT '82, sets out some of his plans. Most of them, so far as personal computing goes, seem to be extensions of existing schemes. They include the Government putting up half the cost of buying computers for schools and giving away 100 computers in a schools essay competition.

Although we live under a Government which supposedly abhors the idea of intervening in industry, it defends the principle of "pump-priming" — injecting a little money to start the ball rolling. However, now that more than a quarter of a million people in Britain own or use a personal computer, and given that the rate of growth of the market is accelerating, it strikes *Your Computer* that the Government has come into the act a little late.

Its offer to help schools buy personal computers looks irrelevant compared with the massive orders taken by Sinclair and the BBC each month. Although we are sure that a number of science teachers would disagree, it is possible that the schools would prefer to have the extra money to buy more textbooks.

Whatever the Government does now is hardly likely to change significantly the way the market develops. Its momentum is such that the most the Government can hope for is a small slice of the action and, on past record, will spend far more money in achieving it than is really necessary.

There are students of politics who would argue that one of the primary roles of a government is to establish the ground rules which the rest of us follow in our business. In many ways *Your Computer* would rather see the Government resolve some of the legal confusions surrounding computing and let us carry on with the business of buying, selling, making and using personal computers. If the Government needs any guidance on some of the areas which need legal clarification, *Your Computer* suggests it starts, after many years of pushing it down its list of priorities, by tackling the thorny question of software copyright.

If any of you ever try to make money from selling some of the games or educational programs you have written only to find some unscrupulous software company making and selling illicit copies, you soon see the need for copyright reform. It is a difficult question, as Kenneth Baker rightly says, but it is exactly the kind of question we elect governments to answer. ■

the vic centre

Adda Computers Ltd., a major supplier of computer systems to industry and business, have opened the Vic Centre in West London. Here you can see, discuss and buy everything to do with the new VIC 20 personal computer—in person or by mail. Hardware, software, technical advice and information is available from an experienced staff. Even if you already own a VIC 20, get on our mailing list to know about new developments. Remember—everything has the backing of Adda's reputation, and there's a full 12-month warranty on all hardware. The Vic Centre is easy to reach—Just off the A40, close to North Acton tube station.

Not just a computer but a whole expandable system

AT ONLY £189·95 inc.VAT. Special cassette deck £44·95 inc.VAT.

The VIC-20 is a fully fledged, easy-to-use computer. It's the core of a great expandable system.

- ★ EXPANDABLE MEMORY—UP TO 32K, USING PLUG-IN MODULES
- ★ DISK DRIVE/CASSETTE—FOR EXTERNAL STORAGE.
- ★ PRINTER—80 COLUMN, 30 CHARACTERS-PER-SECOND

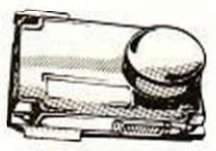
First time users can operate it immediately with plug-in program cartridges, and using your own colour T.V. to get up to 24 colours on screen, four different sound tones and even write your own programs in BASIC. The VIC-20 lets you build a system as needs and budget dictate, so that your VIC-20 can be more than just a personal computer.

VIC-MEMORY 3K £44.85
Small size—low cost memory expansion. Plugs into Vic and reproduces memory-port. Can be used with other expansions gives a total of 6k user static ramon Vic.
FEATURE This board allows Vic to move Basic to begin at 1024 ($0400) as in Pet. and enables the use of HIGH RESOLUTION COLOUR GRAPHICS

VIC-LIGHT PEN £28.75
This high quality light pen works in both normal and Hi-Res modes on the Vic allowing simple interaction with the Vic without keyboard entry.
Easy to program and easy to use.
e.g. Menu selection. Non-keyboard entry. Teaching Games.
FEATURE touch sensitive "Enter" contacts to eliminate accidental entry.

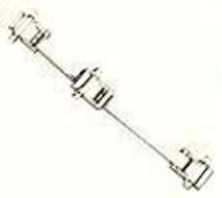
VIC-RS232 INTERFACE £56.35
Fully implemented (true levels) RS232C-V24

BI-DIRECTIONAL INTERFACE
Allows Vic to work as Mainframe Terminal Drive a Qume Daisywheel or a Paper Tape Punch etc. etc.
FEATURE This unit contains master power supply which supports Vic's own supply when carrying Memory Expansions, Cassette Drives, Light Pens, Printers etc.



VIC JOYSTICK Single **£14.95**
Hand-Held joystick units for games use available in Pair or Single configuration. N.B. (2 Singles will not work as a pair unless modified)

VIC-Games Port Adaptor Cable £19.85
A two into one adaptor for use with both joysticks and light pens. A must for those who require full control of games with graphics.
FEATURE low-cost High quality. Robust.



VIC-20 DOT MATRIX PRINTER £229.95
Tractor feed, 80 character-per-line, 30 characters-per-second.

VIC SINGLE FLOPPY DISK DRIVE £ P.O.A.
3K RAM CARTRIDGE £29.95
8K RAM CARTRIDGE £44.95
16K RAM CARTRIDGE £74.95

PROGRAMMERS AID CARTRIDGE £34.95
—an extension of BASIC to aid programming and de-bugging.

MACHINE CODE MONITOR CARTRIDGE £34.95
—includes assembler and dis-assembler capabilities.

SUPER EXPANDER HIGH RESOLUT. CARTRIDGE £34.95
—permits use of high resolution graphics.

VIC software Each of these tapes £14.95

Codebreaker/Codemaker
You play the VIC or the VIC plays you in this computerised version of Mastermind.

VIC Seawolf, VIC Trap and Bounce-out
3 fun games, a submarine shoot out, a beat the VIC and an old favourite pub game.Good games with different skill levels.

Monster Maze and Maths Hurdler
A fun game with good colour and sound and a mental arithmetic learning game. Highly rated by everyone we have shown it to. Harder than you think.

Canyon Fighter, Tunesmith, Star Wolf at **£5.95** each

VIC GAMES CARTRIDGES at **£19.95** each

Fruit Machine, Lander, Road Rally, Alien, Avengers, Poker

TERMS AND CONDITIONS: All goods sold subject to Adda terms and conditions of sale. Full details available on request, but include: 7 day money back guarantee, Adda 12 month hardware warranty. Please allow 21 days for delivery. Allow 7 days for personal cheques to be cleared. **Quoted prices are inclusive of VAT.**

Goods Required _____ Price _____

_____

_____

_____

Add £2.00 p. & p. for orders under £50.00 Total £ _____

Name: _____

Address: _____

_____

SHOP ADDRESS: Adda Home Computers Ltd.
154, Victoria Road, Acton, London, W3. Tel 01-992 9904.
OPEN: 10 am—6 pm (Tuesday—Friday), 10 am—5 pm (Saturday).

YCI

MAIL ORDER to: Adda Computers Limited, FREEPOST, London, W13 0BR or telephone your order (24 hours a day) to 01-992 9904 quoting your BARCLAYCARD OR ACCESS number.

* I enclose a cheque, made payable to Adda Computers Limited for

£.....

* Please charge my Barclay/Access account. My account number is

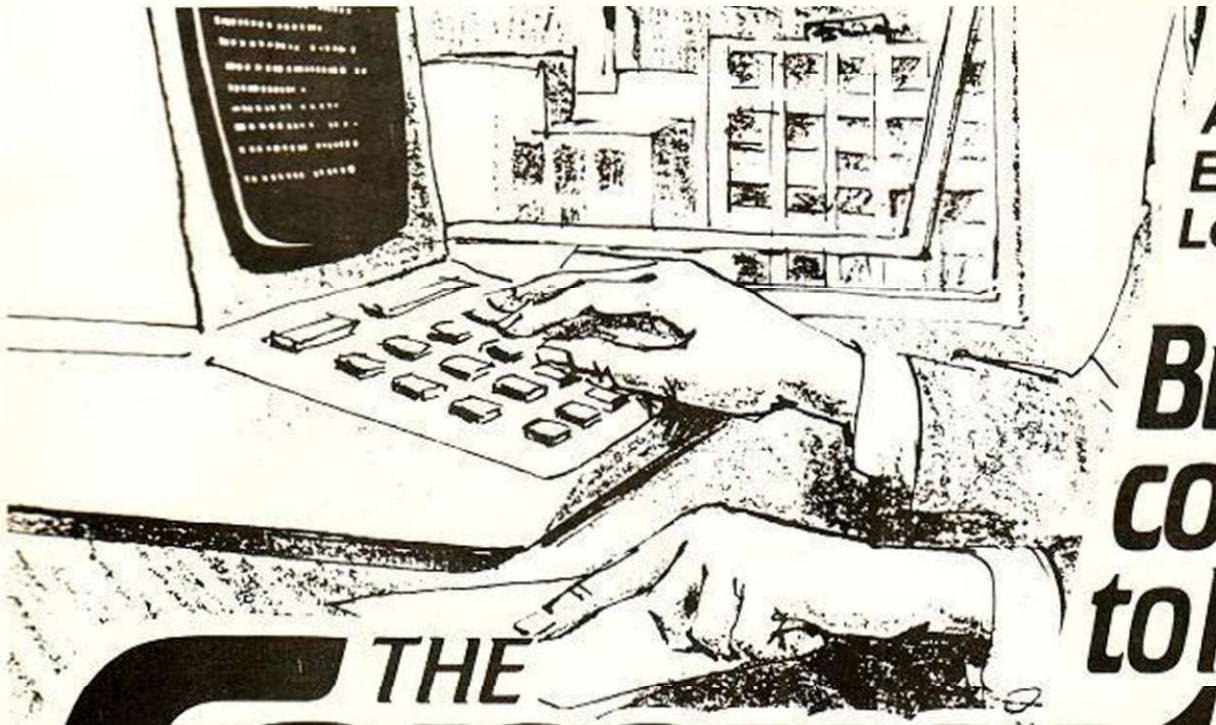
.....

* Please add my name to your mailing list

* Delete as applicable

Date:.....

adda



April 23-25, 1982
Earls Court, London

Bringing computers to life

THE Computer Fair

Personal computers
Home computing
Small business systems

In all walks of life, personal computers have revolutionised computer power — bringing it within the reach of a far wider and more popular market than ever before.

In 1982 this revolution will explode onto the home and personal computer market. To meet this demand, Practical Computing and Your Computer announce a brand new event — The Computer Fair. The promotion of the exhibition will be heavily geared to attract the growing market of potential and existing users of personal computers, from home computer enthusiasts to businessmen.

Bring your computers and services to life — all walks of life — at The Computer Fair!

Complete and return the coupon — we'll send you details.

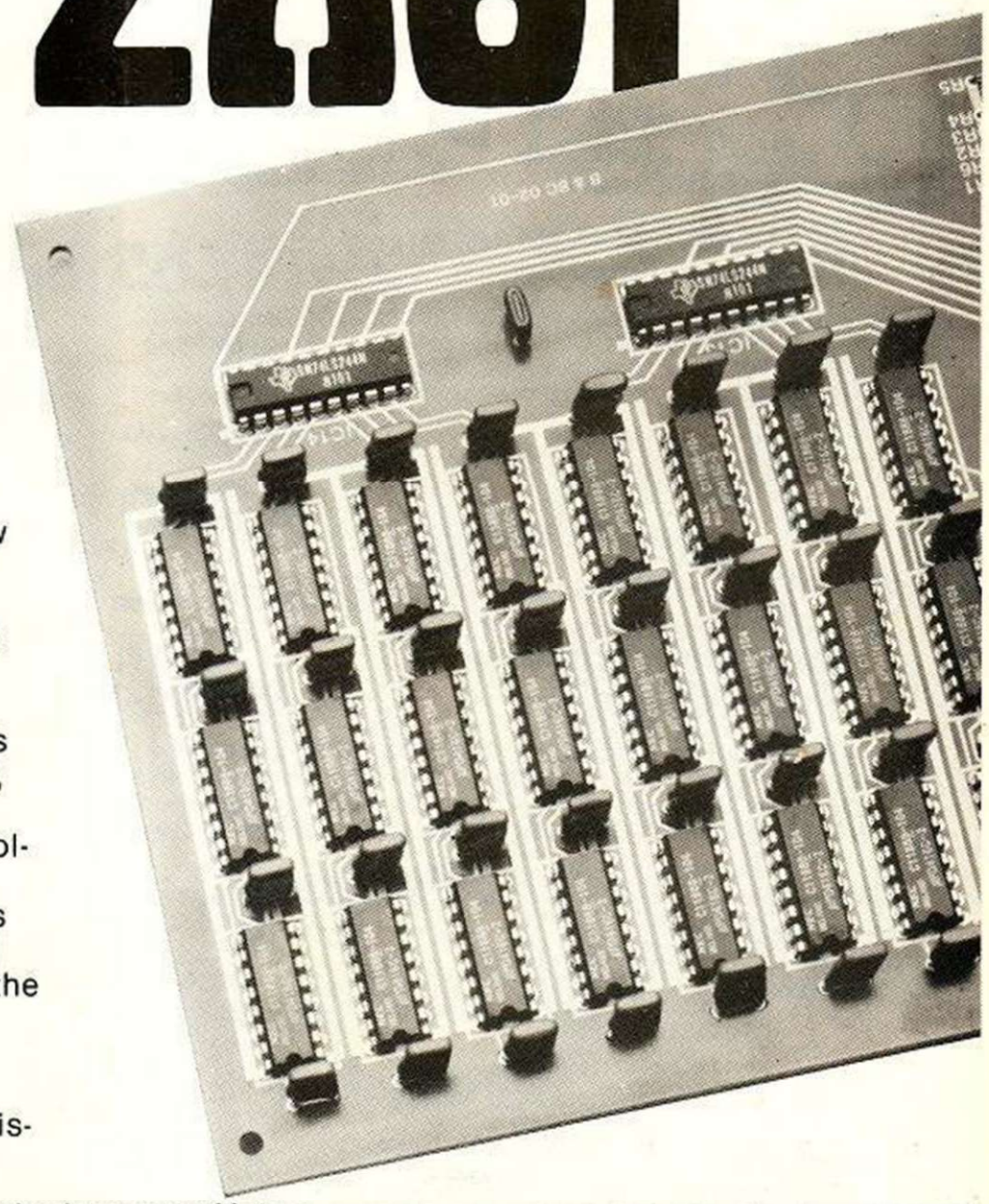
THE Computer Fair
Personal computers
Home computing
Small business systems

Exhibition Manager,
THE COMPUTER FAIR,
IPC Exhibitions Ltd.,
1, Throwley Way,
Sutton, Surrey, SM1 4QQ

Name _____
Position in Company _____
Company _____
Address _____
_____
_____ *Tel. No.* _____

MEMOTECH

48K memory extension for the ZX81



The MEMOTECH memory extension board will allow the ZX81 to run 48K BASIC programs which may include up to 16K of assembly code.
The unit contains a genuine 48K of user transparent RAM, and accepts such BASIC commands as:
10 DIM A(9000).
A range of I/O Port boards and A/D, D/A convertors is available. The unit is compatible with the ZX Printer, and RS232 interface will be available soon.
The MEMOTECH memory has a fully buffered control-data-address bus with PCB 40 way header plug.
The ZX81 sits on a custom built case which contains the **MEMOTECH** memory and a power supply which not only powers the **MEMOTECH** memory, but also the ZX81.
All Leads are provided. The **MEMOTECH** memory extension board costs: £109.00 + VAT in kit form, £129.00 + VAT assembled. 15% Educational user discounts are available.

Please make cheques payable to:

MEMOTECH

(Sales Dept.) 103, Walton Street, Oxford. OX2 6EB.

MicroValue

MONEY SAVERS

with the exclusive MicroValue 12 Months Warranty*

MicroValue Exclusive

MV1 – a Z80 computer

SAVE £107.50

The MV1 computer kit uses the ubiquitous Nascom 1 Pcb and the Z80 CPU. Interfaces are included for television, printer and cassette. 2K memory, Gemini power supply (drives up to 3 extra boards). Cherry full ASCII keyboard and Quantum Graphics are also included. Available with either an ASCII version of the Nas-Sys 3 monitor, or a Tiny BASIC. MV1 is expandable to Gemini 80-BUS specification.

MicroValue price
£105 + VAT

MicroValue Exclusive

MicroValue's 'Nascom Special'

SAVE OVER £65

We've put together a microcomputer kit containing the Nascom 2, Nas-Sys 3, Graphics ROM, Bits & P.C.'s programmers aid, Gemini 3 APSU, 16K RAM Board and mini motherboard. The result is a powerful micro using market proven boards and components.

RRP OVER £405 + VAT

£340 + VAT

MicroValue Exclusive

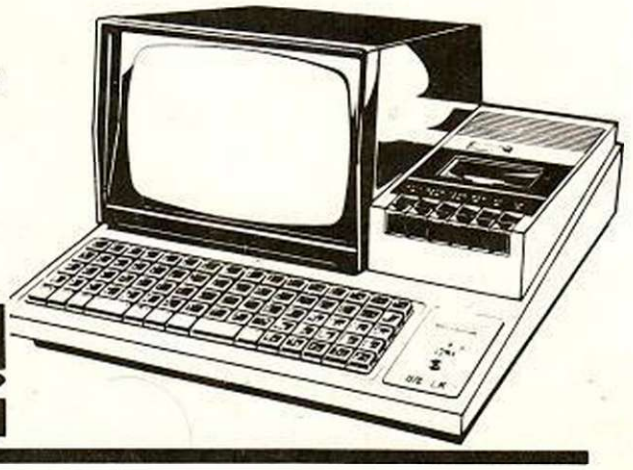
SHARP MZ80K with Super Graphics

SAVE £200!

The 48K RAM System is offered at a rock bottom price with the Quantum Micros Hi Res Graphics which gives resolution down to a single dot and high res. plotting. Characters are user definable and the pixel characters actually *join*. Five free games packages are included too!

RRP £645 + VAT

MicroValue price
£445 + VAT

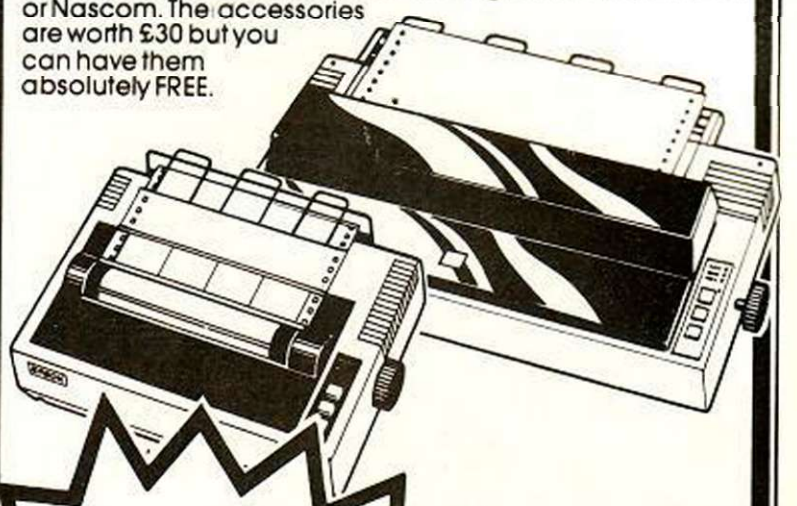


SHARP

£30 worth of accessories FREE with every Epson Printer

	MicroValue price
Epson MX80T	£359 + VAT
Epson MX80FT1	£399 + VAT
Epson MX80FT2	£465 + VAT
Epson MX100	£575 + VAT

Buy one of the above Epsons from MicroValue and we'll give you a Pack of Fanfold paper, Spare Ribbon Cartridge, Interfacing Document and Connecting Cord for Multiboard or Nascom. The accessories are worth £30 but you can have them absolutely FREE.



Cheapest Printer in the UK!

Nascom IMP + Graphics Only £199 + VAT

SAVE £156

MicroValue has slashed the price of the 80cps, 80 column IMP dot matrix printer. And added Imprint's high res. graphics and double width character option. IMP has bi-directional printing and friction/tractor feed.

RRP £355 + VAT
MicroValue price
£199 + VAT

NASBUS Compatible DOUBLE DENSITY Disk System – Available Ex Stock

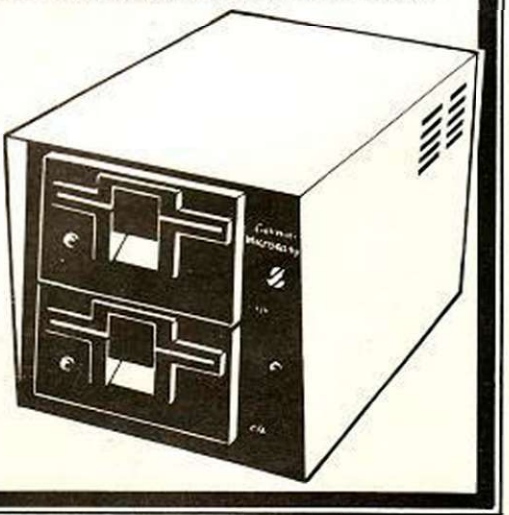
With hundreds in daily use the Gemini Disk system is now the standard for Nascom and Gemini Multiboard systems. Single or twin drive configurations are available, giving 350K storage per drive. The CP/M 2.2 package supplied supports on-screen editing with either the normal Nascom or Gemini IVC screens, parallel or serial printers, and auto single-double density selection. An optional alternative to CP/M is available for Nascom owners wishing to support existing software. Called POLYDOS 2 it includes an editor and assembler and extends the Nascom BASIC to include disk commands.

Single drive system (G809, G815/1)
£465 + VAT

Double drive system (G809, G815/2)
£690 + VAT

CP/M 2.2 package (G513)
£100 + VAT

Polydos 2
£90 + VAT



MicroValue

MONEY SAVERS

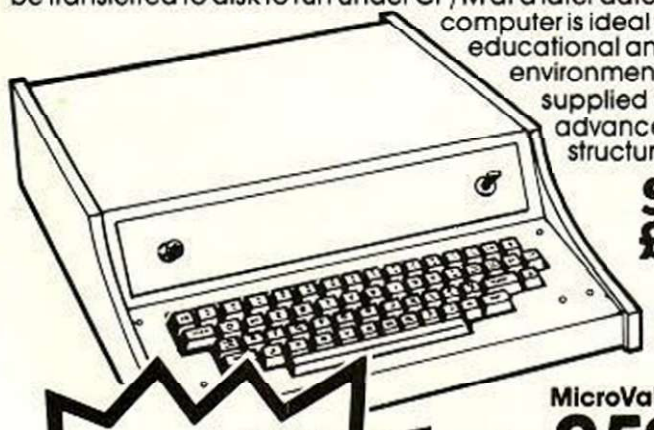
MicroValue Exclusive

with the exclusive MicroValue 12 Months Warranty*

MV2-Twin Z80A Controlled Development Computer

The fully built and tested MV2 microcomputer is controlled by two Z80A microprocessors. Interfaces include RS232, cassette, 2 × 8 bit parallel ports, and graphics including programmable graphics. It provides 80 × 25 screen format and includes 64K RAM, Integral PSU and full ASCII keyboard.

Software written to run under the RP/M ROM based monitor can be transferred to disk to run under CP/M at a later date. This rugged computer is ideal for educational and industrial environments and is supplied with the advanced COMAL structured BASIC.



SAVE £76.50

MicroValue Exclusive

MicroValue price £595 + VAT

80 × 25 Video for Nascom

Nascom owners can now have a professional 80 × 25 Video display by using the Gemini G812 Intelligent Video Card with onboard Z80A. This card does not occupy system memory space and provides over 50 user controllable functions including prog character set, fully compatible with Gemini G805 and G815/809 Disk Systems. Built and tested. **£140 + VAT**

MicroValue Exclusive

NEW I/O Board for Nascom & Gemini Multiboard Systems

Quantum I/O

The new Quantum Micros I/O board takes the unique approach to the problems of interfacing your Nascom or Gemini Multiboard to external devices. This 80 Bus and Nasbus compatible card is supplied fully built, populated and tested and includes three Z80 PIOs, a CTC and a Real Time Clock with battery back-up. In addition, a range of "daughter" boards that attach straight to the I/O board are under development catering for a wide variety of interfacing requirements.

Quantum I/O board MicroValue price – **£140** + VAT

Prototyping daughter board MicroValue price – **£20** + VAT

IEEE-488

The EV Computers' IEEE-488 card is an 80 Bus and Nasbus compatible card designed to fully implement all IEEE-488 interface functions. This built and tested card gives the user a very cost effective and versatile method of controlling any equipment fitted with a standard IEEE-488 or GPIB interface.

MicroValue introductory price

£140 + VAT

MicroValue Exclusive

New Software for Nascom Systems

POLYDOS 1 A disk operating system for use with Nascom 1 or 2 and Gemini G805 Disk Systems. An incomparable and extremely well presented DOS that includes an editor and assembler and adds disk commands to the Nascom BASIC. MicroValue price **£90 + VAT**

MATHSPAK Double precision maths package on tape. MicroValue price – **£13 + VAT**

MATHSPAK Handler Used in conjunction with MATHSPAK. MicroValue price – **£9.95 + VAT**

Command Extender For use with MATHSPAK it extends BASIC's reserve word list. MicroValue price – **£9.95 + VAT**

Logic Soft Relocater An integrated assembler and disassembler package which allows disassembly and reassembly from anywhere on the memory map. MicroValue price – **£13 + VAT**

SAVE MORE MONEY

Standard Firmware for Nascom at Reduced prices

NASPEN	RRP £30 + VAT	**MicroValue price £20 + VAT**
Nas-Sys 3	RRP £25 + VAT	**MicroValue price £20 + VAT**
NasDis + D-Bug (EPROM)	RRP £50 + VAT	**MicroValue price £30 + VAT**
NasDis + D-Bug (TAPE)	RRP £40 + VAT	**MicroValue price £20 + VAT**
Imprint	RRP £30 + VAT	**MicroValue price £20 + VAT**
Bits & PCs Prog. Aid	£28 + VAT	**MicroValue price £20 + VAT**

*MicroValue Warranty

All products, except kits, sold by MicroValue dealers are supplied with 12 months' warranty and will be replaced or repaired by any dealer (even if you didn't buy it from him) in the group in the event of faulty manufacture.

YOUR LOCAL MICROVALUE DEALER

All the products on these two pages are available while stocks last from the MicroValue dealers listed on right. (Mail order enquiries should telephone for delivery dates and post and packing costs.) Access and Barclaycard welcome.

BITS & PC'S
4 Westgate, Wetherby, W.Yorks.
Tel:(0937) 63774.

ELECTROVALUE LTD.
700 Burnage Lane, Burnage, Manchester M19 1NA.
Tel:(061) 431 4866.

28 St Judes, Englefield Green, Egham, Surrey TW20 0HB.
Tel:(0784) 33603. Tlx:264475.

SKYTRONICS,
2 North Road, The Park, Nottingham.
Tel: (0602) 45053/45215

TARGET ELECTRONICS
16 Cherry Lane, Bristol BS1 3NG.
Tel:(0272) 421196.

INTERFACE COMPONENTS LTD.
Oakfield Corner, Sycamore Road, Amersham, Bucks.
Tel:(02403) 22307. Tlx:837788.

HENRY'S RADIO
404 Edgware Road, London W2.
Tel:(01) 402 6822.
Tlx:262284 (quote ref:1400).

LEEDS COMPUTER CENTRE,
62 The Balcony,
Merrion Centre, Leeds.
Tel: (0532) 458877

INNOVATIVE
TRS 80-GENIE SOFTWARE
from the professionals

AJEDIT
....a new, simple to use, moderately priced word processor

The introduction of a brand new word processor is a major event and AJEDIT is without doubt a major program. There are, however, quite a few Word Processors around and most of them are extremely good ones - why, therefore, another? The question is even more pertinent when it is known that we specifically commissioned the writing of it from an author of the status of Denville Longhurst of Enhanced Basic fame. The answer is that user feedback shows that a large number of customers do not need or want word processor programs which require a quantity of training before use. Scripsit, for instance, is an excellent program, but is complex to use; it even comes with a training course on tape. If one operator is dedicated to using the word processor then it makes sense to have her trained, and the more complex the program (so long as the complexity is accompanied by more and bigger functions) the better.

AJEDIT has been written for the user who needs a word processor intermittently, say three or four times a week. Its prime design criteria was ease of use - and just as importantly - ease of recollection of its commands. Take, for instance, the text editing commands - they are as close to the Basic Edit commands as possible, so that the user will remember them: To insert type I, to delete D, to take out three letters type 3D and so on.

Furthermore, AJEDIT has benefited from being written after a number of other word processors. The deficiencies in its predecessors are corrected in AJEDIT. For instance, any control characters can be outputted so that full advantage can be taken of the features of the particular printer being used. Disk directory access is available from within AJEDIT as is the killing of files on the disk. The FREE command and a number of other DOS commands can be carried out from within the program with a return to AJEDIT - with its text intact.

AJEDIT contains close to one hundred commands covering most word processor requirements. Dedicated printer commands for the Epson MX series and the Centronics 737 are included - again for ease of use of these two popular printers.

One of the big features of AJEDIT is the ability to "mail-merge". The facility is available whereby two special files are created, one containing names and addresses and a salutation, the other a standard letter or form. AJEDIT will call the address and salutation from one file and the letter from the other and thereby compile personalised letters. The salutation may be repeated in the body of the letter.

AJEDIT needs 48K and one disk minimum and is suitable for the TRS-80 Models I and III and the Video Genie Models I and II.

AJEDIT **£49.95**
Inclusive of V.A.T. and P. & P.

MOLIMERX LTD
A J HARDING (MOLIMERX)

1 BUCKHURST ROAD, TOWN HALL SQUARE, BEXHILL-ON-SEA, EAST SUSSEX.

TEL: [0424] 220391/223636 **TELEX 86736 SOTEX G**

TRS-80 & VIDEO GENIE SOFTWARE CATALOGUE £1.00 [**refundable**] plus 50p postage.

YOUR LETTERS

RENUMBER AGAIN

I was pleased to see my ZX-81 renumber program published in the November 1981 Software File. The program will work in a 1K machine, but if run on a 16K ZX-81, it will crash.

The problem lies in the machine-code routine — the 15th byte, to be exact. This byte should be 0 and not 118 as shown. This can be easily rectified by changing M(15) to 0. I hope this did not cause too much confusion with any readers who own a 16K machine.

James Tyler,
Portsmouth.

GIRLS DO COMPUTE

The November 1981 issue was the first copy of *Your Computer* I have seen. First impressions were very favourable. Then I read the editorial, "Why don't girls compute?". The first three paragraphs may be fact, the final two which contain sentences like: "The other culprits are the schools" and "Let's tell the teachers to think again" nearly made me blow a fuse. When did the writer last spend time in a school and where does he find these fantasies he presents as facts?

Visit an ordinary neighbourhood school such as the secondary school where I teach. For at least the last five years, all pupils in their first three years here have done everything. They must have this opportunity by law. So, boys and girls cook, sew, do wood and metal work, technical drawing, all the sciences, at least one foreign language and a substantial number have a taste of practical electronics plus the usual mathematics, English and religious education.

When the moment arrives to choose subjects to study for a further two years to O or CSE level, the old separation of the pupils, of which the editorial complains, reappears.

Very few girls opt to take technical subjects. Only one girl in 10 years has followed our O-level technology course. The proportions in the sciences are not so bad, though the balance is in favour of the boys.

The root cause of this phenomenom is cultural — it is part of the underlying structure of society which determines what boys and girls do. Nothing is going to alter that overnight — not editorials, nor teachers driving themselves frantic about able girls not developing their obvious scientific and technical ability, nor even the substantial financial discrimination in favour of girls taking technical subjects in further and higher education as promoted by the Engineering Industry Training Board.

Interestingly, a good many boys choose to do O-level home economics — but then, that is culturally acceptable as men have always been cooks and chefs, and good ones, too. We find girls wanting to do the so-called boys' subjects but, to our despair, they cannot withstand pressure from parents and peers to do otherwise.

It takes a good deal of courage and drive to break out of the cultural mould. However, educational researchers have found that in all-girls' schools the problem is of minor significance and some very good scientific and technical work is done in these schools.

As far as computing goes, for a number of years we have run an O-level computer studies course with a terminal linked to Hatfield Polytechnic and now additionally with a 380-Z bought with money raised by all the pupils. Of the 120 pupils currently on the course, 63 are girls. The teacher is a woman — and so was her predecessor.

So, please do not attack teachers and schools. Find out what we manage to achieve despite seven years of educational spending cuts. Support us in the fight against cuts proposed for 1982/83 which will make anything in the past look insignificant.

P L Patient,
Heronswood School,
Welwyn Garden City,
Hertfordshire.

LOADING TROUBLE

In your October edition D Somerville has a query regarding the use of a cassette recorder with a ZX-81. I experienced similar problems, on a borrowed computer, until I tested the interconnecting leads supplied by Sinclair.

I found that the yellow-marker sleeves fitted at each end were not on the same lead, so that the microphone socket on the ZX-81 was connected to the ear socket on the recorder and vice versa. Rectifying this fault made a considerable difference.

However, I still found difficulty in loading from one recorder using a cassette which had had a program saved on another. The solution seemed to be to Load from the original recorder and then Save on the new one. Reliable results have been obtained since then.

J D Cheal,
Eastleigh,
Hampshire.

MANUAL MISTAKES

I received my Sinclair printer this week — two months after my order — and have been very happy with its performance. Potential owners of the printer may be interested to know that a new transformer is supplied, paper refills cost £12 for a five-pack and the printer manual contains at least three mistakes.

A high-resolution graph can be plotted in a 9cm. square area using 256 by 256 points, these points are stored in an 8K character array and the method is adequately described in the printer manual. I was unable to plot the last few rows of the array before I noticed an error in the manual: line 9989 on pages 14 and 16 should read:

```
9989 For I=0 TO 256 step 8
```

A worked example is supplied for a sine and cosine graph. However there is a discrepancy between the description on page 6 and its graph on page 17, the straight line plotted should have been a cosine curve. Line 110 on page 16 should read:

```
110 Let Y = 128 + 120 * COS
    (X/128*PI)
```

I would suggest a 16K pack be bought before a printer if the printer is to be used to its full potential.

Paul Cook,
Woking,
Surrey.

VISUAL HANDICAP

The letter in Response Frame November 1981, from registered blind enthusiast F A Norton interested me very much. I had the same problem about 18 months ago — I am limited to some vision in one eye.

The computer I finally chose was the TRS-80, mainly because of its ability to display either 32 or 64 characters per line — an invaluable facility when writing and listing programs. Using a portable TV was not so successful, as there is an inevitable blurring of text and graphics, so I recommend investing in a proper VDU.

Perhaps others with vision problems would like to contact me; it might be possible to exchange ideas and tips. Write to me at: Flat 5, 24 Windlesham Gardens, Brighton, East Sussex BN1 3AJ.

P V Bamfield
Brighton,
East Sussex.

ATOM SOFTWARE

I have been reading Eric Deeson's article in the November issue of *Your Computer,* concerning Atom software. I am amazed at the huge range available for the Atom: it seems that programs are becoming better and cheaper all the time.

I sympathise with him for the problems he has had in loading programs. My advice to people who buy cassettes from software companies is to save the programs on your own tape as soon as you have loaded them and checked that they are working properly. This has several advantages:

- If your cassette is a good-quality one, you should not have nearly as much trouble in loading.
- You can record a program at the desired volume and tone levels.
- Loading is generally quicker for long machine-code programs from your own cassette than it is for the software cassette.

Though I admit that the description of the editing system in the Acorn manual is not very good, all becomes clear when using the keyboard. The essential thing is that the Edit keys must be used with the Copy key — pages 132-133.

P Gibbon,
Norwich.

COURTEOUS CLIVE

After the modifications suggested by P R Ainsworth in Software File November 1981 I can now enter into my 16K RAM programs without breaking into a sweat after line 200. Sinclair Research has been both courteous and prompt in sending me a replacement RAM after I sent the original back.

If anyone is suffering from eye twitch as a result of the hours spent staring into a black-and-white TV monitor, he might care to try placing a small sheet of smoky transparent Perspex in front of it.

Raymond Akhurst,
Forres, Scotland.

ZX REPEAT-UNTIL

Much has been written in recent months about the convenience and simplicity of the Pascal-like statements Repeat and Until, which have been incorporated in some more recent versions of Basic. I have found my ZX-81 has a feature which allows Repeat-Until to be simulated relatively simply.

The secret is that in ZX-81 Basic, the expression-evaluator routine takes the highest priority, so that the statement Goto (expression) is valid, provided the evaluation of the said expression returns an integer value.

Thus the loop

```
      10 REPEAT
      12
loop  14
      16
      18
      20 UNTIL (condition)
```

may be implemented in ZX-81 Basic by

```
12 (beginning of loop)
14
16
18
20 GO TO (condition) *9 + 12
```

If the condition is false, the program will return to line (0)*9+12 — i.e., 12 — and if the condition is true, the program will proceed to line (1)*9+12 i.e., 21 — to jump out of the loop.

N Haughton,
Wokingham,
Berkshire. ■

Sharp's sound of music

A NEW TYPE of microcomputer software has emerged — music programs for home computers. Maris and Tresham have written a series of music programs for the Sharp MZ-80K microcomputer which has an integral loudspeaker. The writers maintain that among the collection there is music for all the family.

For the younger computer user there is Rhymes, a selection of 20 favourite nursery ryhmes with both words and music. The program is easy to operate and can even be run by very small children.

Melody is a musical quiz game for up to six contestants. A fragment of a popular tune is played and the title must be guessed. There are three levels of play and a total of 3,500 possible combinations. All three programs are available from Newbear Computing Stores and Sharp dealers. Further details from Maris and Tresham, 19 Pytchley Way, Brixworth, Northampton

Hearing is believing

TELESOUND 82 WILL find a receptive audience among *Your Computer* readers who have no integral sound-generation facilities on their micro-computers. The device is suitable for most of the more popular home computers and fits them in a manner which enables the generated sound effects to be heard from the television loudspeaker.

Sound is modulted and then fed to the UHF video modulator, where the combined signal is decoded by the television set so that both the sound and vision appear from the same source.

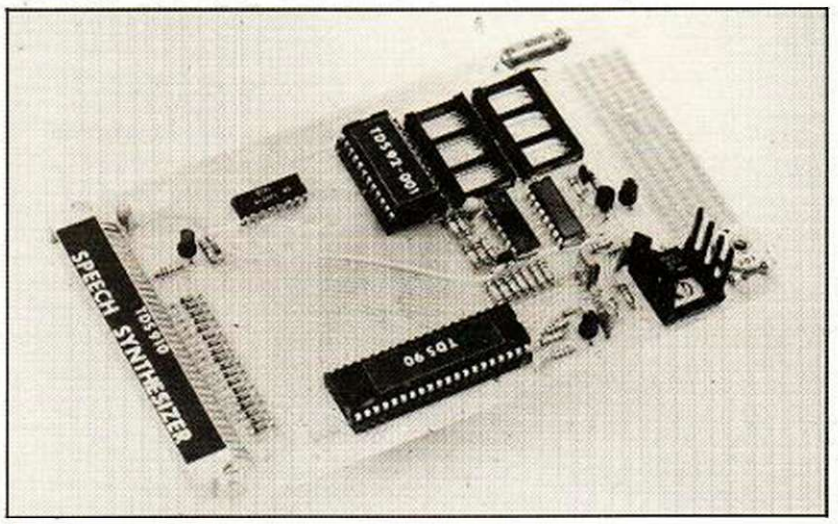
Sound effects are generated by programming the microcomputer's cassette output. The desired effect is controlled entirely by software. If the computer system already has a sound effects board then the Telesound unit connects to the audio output eliminating the need for amplifier and loudspeaker. Help in programming can be given to computer users, hoping to use the unit in conjuction with the ZX-80, ZX-81, Atom, Microtan, TRS-80, Apple and Nascom microcomputers.

Telesound 82 is supplied ready-built and tested. Four connections are required, one to the audio source — in most cases the cassette output — one to the UHF video-modulator input. These connections are made by leads with alligator clips eliminating the need for soldering.

The two other connections are to the power supply. Details are supplied to enable the unit to be fitted either remotely or within the computer case. This is possible because of the minute size of the device — about the same as an Astec UHF video modulator.

The Telesound 82 unit costs £9.95 and is available from Compusound (U.K.) Limited, 32, Langley Close, Redditch, Worcestershire.

How TDS-934 delivers speech



THE EUROCARD version of Triangle Digital Services speech synthesiser forms the basis of a series of products which enable the computer user to create speech. The Eurocard 910 retails at £97.06. However, the TDS-934 chip set costs only £39 and contains the essentials for a speech-generation system using Triangle's own Instant Speech method.

The TDS-934 set comprises a speech synthesiser TDS-90 and speech memory TDS-92-001, together with four normal integrated circuits which provide the voltage regulation and the requisite analogue filtering.

The device does not necessarily require a microprocessor to operate, though it helps. Simple switch closures can generate 16 different phrases.

For more details contact Triangle Digital Services Ltd, 23 Campus Road, London E17 8PG. Telephone: 01-520 0442.

The Computer Fair caters for all

THE FIRST Computer Fair is to be held this spring at Earls Court exhibition centre. The Fair, jointly sponsored by *Your Computer* and *Practical Computing*, will concentrate on three areas: home computing, small-business computing and personal computing. The Fair will run from Friday, April 23 to Sunday, April 25.

The Computer Fair will literally have something for everybody, from games on microcomputers — space invaders *et al.* — to systems for the small business, and everything in between. The U.K. final of the Euro-Micromouse competition will be held at the show. It is a competition where little robots or micromice hunt for the centre of mazes. The winner is the robot mouse which reaches the centre of the maze in the fastest time.

Serious computer users will be catered for — this will give anyone who needs one an excuse to attend — and you may leave having bought yourself a brand-new office system. Computers are making inroads into other areas of activity; at the Computer Fair you will be able to see every facet of microcomputers in the modern world

The show is being organised by IPC exhibitions, which already runs Compec, and it occurs at a seminal point in the history of micro-computers — not only is 1982 the Government's Information Technology Year, it is the year of the BBC microcomputer series and of an explosion in the sales of micro-computers at the bottom end of the price scale.

British Telecom offers £1,000 prize for best Sinclair Prestel adaptor

BRITISH TELECOM has put up a £1,000 prize for the designer of the best Prestel adaptor for the Sinclair ZX-81. The object is to stimulate the growth of telesoftware — programs sent via Prestel.

Ideally the ZX-81 will load executable code from a Prestel frame direct into the ROM of the ZX-81, ready to run. The adaptor, which will require hardware construction as well as software, should:

- Comply with British Telecom requirements for attachment.
- Be capable of eventual production, and of future development.
- Permit the use of the Council for Educational Technology (CET) telesoftware format.
- Be "in the spirit of the ZX-81".

This ZX-81 plinth, moulded in a matt-black plastic, is designed to raise and tilt the television monitor to minimise eye strain. The unit will hold the ZX-81 microcomputer, the 16K RAM pack and hides the wiring and power supply. The ZX-81 plinth costs £15, a built-in power switch costs a further £3, postage is £1.50. All prices include VAT. Contact Peter Furlong Products, 125 Catford Hill, London SE6 4PR. Telephone: 01-690 7799. Credit Card orders will be accepted by Telephone.

In practical terms this last proposition means that the adaptor should combine low price, elegant design and robustness. The entries will be judged by Dr Ederyn Williams of Prestel and it is hoped that Clive Sinclair will take an active interest. Entries should be at Prestel HQ by March 14, and the best ones will be shown at the Computer Fair, April 23-25.

Would-be constructors will need to invest in a copy of the Prestel technical specification, price £10. A working prototype capable of being modified so as to receive approval for attachment to the telephone network must be submitted to Prestel, but the design will remain the property of the designer — giving the added incentive of run-on profits.

Further details, with specification and entry forms, are available from Tony Sweet, Prestel HQ, Telephone House, Temple Avenue, London EC4Y 0HL.

Expand control possibilities

THE P-PACK is a unit which plugs into the rear of the Sinclair ZX-81 microcomputer. Not only does the unit add an extra 5K of user memory, expanding the possibilities of the computer, but it also adds an eight-bit input port and an eight-bit output port. That means the micro can be used in applications.

DCP, the manufacturer, claims that the unit will control anything from a train-set to a production line. The entire package is contained in a black plastic case which matches the case of the ZX-81. The pack is provided fully assembled, readily tested and guaranteed. Retail price of the P-Pack is £37.95 inclusive and the unit can be purchased by mail order directly from DCP.

DCP is a new electronics company which aims to develop and design a range of products which initially will be add-ons for other manufacturers' products. The address is DCP Microdevelopments, 2 Station Close, Lingwood, Norwich NR13 4AX. Telephone: Norwich (0603) 712482.

Bug-free machine code

MACHINE-CODE programming on the Sinclair ZX-81 microcomputer is no easy task but now a debugging program provides the answer. The classic problems are how to store machine code, where to store it, and the saving and loading cassette operations. To remove these obstacles, a fast machine-code debug program has been developed by Picturesque. The software will run on an expanded ZX-81 and is called ZX-MC.

It has a number of facilities, but the most useful are the ability to save a named file to cassette from any RAM area upwards of 4E00H at twice the speed of a Basic save routine.

Of course, the converse function exists, the loading of the file back to the correct area of RAM.

Other facilities include the ability to inspect memory locations and enter hexadecimal op-codes, the ability to inspect and manipulate the Z-80 CPU registers, and the execution of routines from a specified address. Breakpoints can be entered to return control to ZX-MC, and a return from a breakpoint will give no ill effects. It is possible to insert or delete up to 255 bytes in a routine, without destroying the subsequent code.

The ZX-MC program resides in about 2.5K of RAM above the area occupied by Basic. This means that the display RAM — D file — does not move.

ZX-MC is available on cassette together with full documentation and costs £6.50.

Other programs from Picturesque are a Life program and a suite of machine-code routines. Picturesque, 6 Corkscrew Hill, West Wickham, Kent. Telephone: 01-777 0372.

Recalled Vic transformers

A "TECHNICAL fault" lies behind the Commodore moves to recall all transformers distributed with the initial batch of Vic-20 microcomputers. According to a Commodore spokesman: "One of two are not up to scratch".

The 4,000 Vic users affected have all been contacted by Commodore. The computer itself is not at risk as the transformer is a separate unit.

Another problem of concern to potential Vic users is slow delivery. Among the many explanations circulating to account for it is the mysterious loss of a lorry-load of Video Interface Chips en route to the West German factory.

New ZX-81 program launches

SOFTWARE FOR the ZX-81 seems to be multiplying daily now — it is hardly surprising considering the large number of these computers in circulation. Artic Computing recently launched a ZX-81 chess program and has since then upgraded it, making it both faster and stonger. New features include random opening moves, a recommendation of the best move for the player together with an extra level which enables lightning chess.

The chess program has a club rating of around 110 at level three, which takes one minute per move. The program retails at £15. If anyone has purchased the original program it will be updated for £5.

For games players who find chess is not their cup of tea, Artic has a version of the popular Adventure game. Called Adventure B, the new game has 57 locations and 60 objects. Data can be saved to tape enabling the player to return to a game at a later date. Adventure B costs £9, and a third adventure game will shortly be available.

Not everyone uses the ZX-81 just for games — to satisfy the needs of these users Artic Computing has ZXbug. This useful item of software has been rewritten and many functions have been added including cassette routines and a disassembler. The program retails at £9. Artic Computing can be found at 396 James Reckitt Avenue, Hull, North Humberside.

Starting your own business

IF YOU HAVE ever thought of starting your own business and you own a ZX-81, then the package from S Electronics may be of interest to you. The program moves into its own in those situations where a product is manufactured or bought and sold in batches and provides the information required to build up the venture as fast as possible without overtrading.

Included on the cassette is a game varient of the program; both programs fit in the unexpanded 1K version of the computer. S. Electronics is located at 1 Orchard Road, Hayling Island, Hampshire. Telephone: 07016-5191.

Software and hardware harmonise for Tandy

TRS-80 USERS can now enter the world of stereo-music synthesis with Orchestra-85, a fascinating new package which comprises both software and hardware. Music and percussive sounds can be synthesised with this new device from Software Affair — a Californian company which specialises in add-ons for home computers. The package should be available at dealers in the U.K. from the spring.

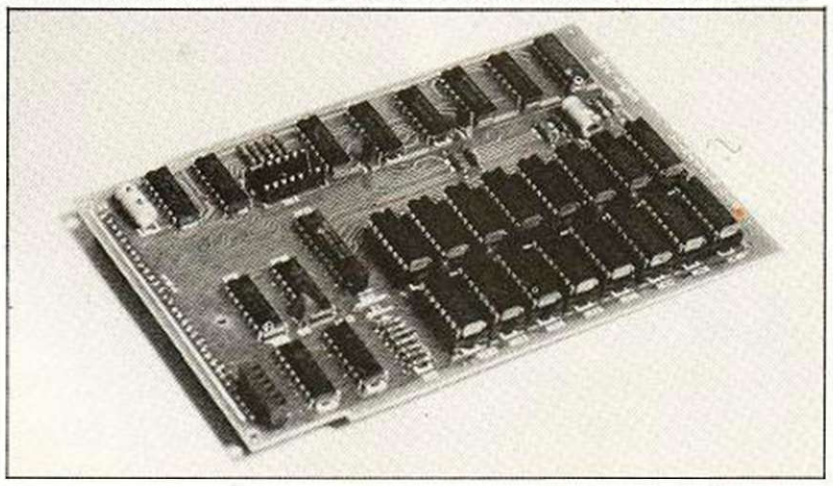
The stereo separation is by instrument. This means that, for example, trumpet and oboe can play through the left channel while clarinet and organ can play through the right-hand one. You can create a wide range of percussive sounds and special effects at the same time or, if required, separately.

The software provided enables the creation of five-part harmonies. Clock speeds are, of course, important in the creation of music; the Orchestra-85 can cope with 2.66. 3.54, and 4MHz speeds.

Music can be entered as sheet music into the system's full-screen text editor, or loaded directly from files. The unit is supplied together with software on tape, sample music files, and an instruction manual.

Orchestra-85 plugs into any 16K TRS-80 level II keyboard without invalidating the microcomputer's warranty, and without the need for a separate power supply. The high-level stereo output may be connected to the aux/tape tuner inputs of any stereo amplifier.

The 32K memory-extension board for the Acorn Atom is part of a range of memory-extension boards which fit inside the Atom case or are provided with a standard connector. The Atom board is available in both 16 and 32K versions, extending the machines memory to either 28K or 38K. The on-board decoding allows the added memory to be located at any 1K address boundary onward. The 16K Atom extension costs £59 and the 32K version, £74. Versions with DIN connector 41612 cost £62 for the 16K version and £76.50 for the 32K. All the boards are available from Timedata Limited, 57 Swallowdale, Basildon, Essex SS15 5BZ. Telephone: 0268-23234.



ZX80/81 HARDWARE/SOFTWARE

2K RAM PACK	£15.95
4K RAM PACK	£22.95
16K KIT	£32.95
16K ROM PACK	£42.95

DEFLEX
LIFE & 3D/3D £5.95
on one cassette

ZX KEYBOARD	£27.95
16K SOFTWARE CASSETTES	from £3.95
4K GRAPHIC ROM	£29.95

ZX KEYBOARD

One of the biggest problems with the Sinclair computer is that the keyboard is rather a finger ache. This has now been solved with the aid of a full size keyboard which is suitable for the 80/81. This is not a revamp of a commercially available keyboard; it has been designed for the Sinclair. This makes it unique. Our keyboard measures 10.25 inches by 3.5 inches and is of course fitted with push type keys, which makes programming a lot more interesting and very much quicker. Because the keys have a positive feel you don't have to keep looking up to the screen and this helps to stop eye strain. The lay-out is the same as your touch sensitive one in that it has 40 buttons; we have allowed facilities for 4 extra buttons to be added. So you could add an on/off switch or a reset etc. We use a two part type of key top. This enables us to have all the normal functions, graphics, letters etc on the keys. They are then fitted under the clear part of the top so they cannot be rubbed or wear off. This is the only reasonable way to get ZX81's 5 functions on the tops. The keyboard is a completely free-standing item. The keys are mounted at an angle so the keyboard has a sloping front. It has rubber feet stuck to its base so that it does not slide around. The keyboard is connected to your computer by 13 coloured ribbon.

MEMORY

2-4K RAM PACK. The 2-4K RAM expansions both use static RAM memory chips, they also both work with the original 1K of RAM inside the computer. This means that the 2K = 3K and the 4K = 5K. They both use the same PCB so if you bought the 2K you could increase it to 4K at a later date. Both the memory expansions plug into the port at the rear of the computer. All dK memory expansions work with the printer, and need NO additional power supply.

THE ABOVE RAMS NEED NO EXTRA POWER AND WORK FROM YOUR SINCLAIR POWER SUPPLY.

16K RAM PACK. The 16K RAM uses 4116 dynamic RAM chips and is similar to the Sinclair RAM pack. We use the dynamic as they are much denser than static RAM and occupy less space; they are also much cheaper than the equivalent product using the static RAM. With our 16K RAM you will also receive a new power supply — it is a direct replacement for your Sinclair supply and is used in the same way, the old supply no longer being used. It is rated at over 1 amp; this will give you plenty of spare power for other ZX add-ons. The RAM pack is manufactured with high quality materials, and uses high-speed low power RAMs. The 16K is also available in a kit version with a saving of £10. The kit is very simple to put together but you must have a knowledge of soldering. The same power supply is also supplied with the kit (as above) and a full set of instructions, diagram etc are included.

16K 81 SOFTWARE

DEFLEX. This totally new and very addictive game, which was highly acclaimed at the Microfair, uses fast moving graphics to provide a challenge requiring not only quick reaction, but also clever thinking. One and two player versions on same cassette. £3.95

3D/3D LABYRINTH. You have all seen 3D Labyrinth games, but this goes one stage beyond; you must manoeuvre within a cubic maze and contend with corridors which may go left/right/up/down. Full size 3D graphical representation. £3.95

CENTIPEDE. This is the first implementation of the popular arcade game on any micro anywhere. Never mind your invaders etc this is positively shining, the speed at which this runs makes ZX invaders look like a game of simple snap. £4.95

Please add £1.00 p/p for all hardware.

Software p/p free.

Specify ZX80/81 on order.

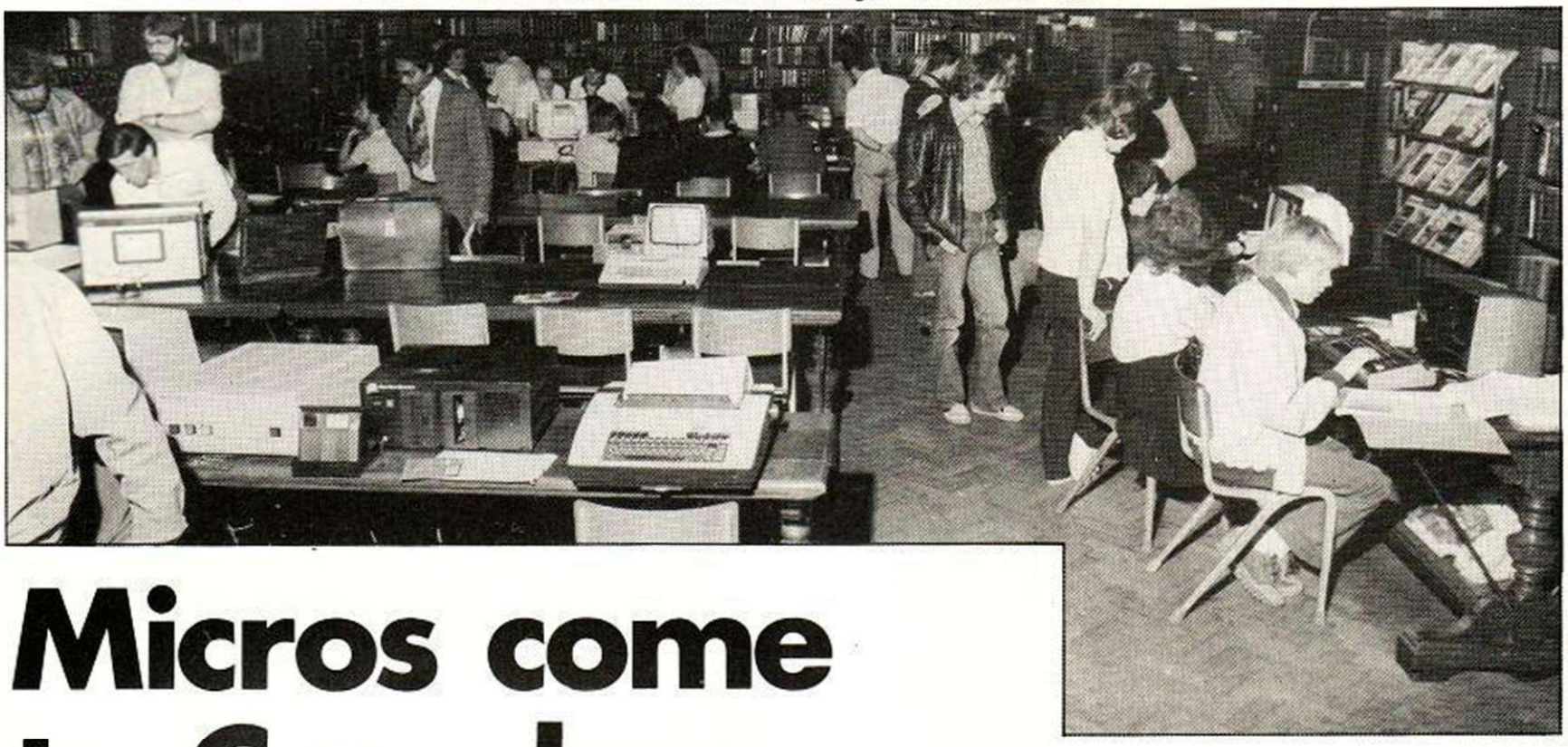
ALL OUR PRODUCTS ARE COVERED BY A MONEY BACK GUARANTEE.

4K GRAPHIC ROM

The dK Graphic module is our latest ZX81 accessory. This module, unlike most other accessories, fits neatly inside your computer under the keyboard. The module comes ready built, fully tested and complete with a 4K graphic ROM. This will give you 448 extra pre-programmed graphics; your normal graphic set contains 64. This means that you now have 512 graphics and with their inverse 1024. This now turns the 81 into a very powerful computer, with a graphic set rarely found on larger more expensive machines. In the ROM are lower case letters, bombs, bullets, rockets, tanks, a complete set of invaders graphics and that only accounts for about 50 of them; there are still about 400 left (that may give you an idea as to the scope of the new ROM). However the module does not finish there: it also has a spare holder on the board which will accept a further 4K of ROM/RAM. We have a tool kit ROM (coming soon) which will use this holder. You could also use this holder with a 411B (1K) or 6116 (2K) RAM chip, and then have user definable graphics, should you wish to define your own graphic set. Machine code can also be stored and run if you fit a RAM in the holder. As you can see this is not one add on, but three — all of which are very useful additions to your computer. You can also use the spare holder for your own programmed EPROMs. The graphics are all available from your keyboard under SOFTWARE control: no buttons or switches and no special routines.

dK'tronics

23 SUSSEX ROAD, GORLESTON, GREAT YARMOUTH, NORFOLK.
TELEPHONE: YARMOUTH (0493) 602453



Micros come to Croydon

David Pollard visits a thriving south-London group.

CROYDON MICROCOMPUTER Club is definitely thriving — its two meetings a month at the borough's Central Reference Library attract between 40 and 100 members and a variety of machines. ZX-81s are understandably popular with UK101s a close second, plus a representative selection of the more expensive machines.

A few of the first batch of BBC Micros have now arrived and are being put through their paces with interest. The on-board sound chip of the micro might well lead to the computer becoming the 1980s' equivalent of the electric guitar.

The club was founded in 1980 and originated, as do many such projects, from conversations in the local hostelry. After a meeting of their club, five or six members of the British Computer Society, which is also based in Croydon, were discussing the need for a local micro club — from that it just grew.

It has certainly snowballed and the connection with the BCS has been maintained. The "mainly mainframe" men were evidently impressed when Croydon MCC took along a selection of tiny machines — to them, anything less than 5Mbyte memory — to a recent BCS lecture about the power of the micro.

There remains a reciprocal agreement whereby members of one group can attend the other's meetings. Outsiders also are welcomed — the associate membership fee is a modest 50p.

The club's success has been ascribed to three main reasons: there is a core of senior members with experience and dedication; meetings are not held too frequently with the result that the quality is kept high; and the meetings are held on a regular basis.

The first meeting of the month takes the form of a formal talk on subjects such as networks, word processing and operating systems. The second is for special-interest groups where the members divide into bunches of five to 10 to teach and learn Basic at various levels, machine code, hardware techniques, specialist programming, and to work on various projects.

Sound production

David Annal is the secretary: his Interface Symposium was certainly stimulating and gives a good example of one of the formal talks. Having covered the means of entering signals, analogue and digital, into the computer, he illustrated the techniques used to obtain suitable outputs with the example of sound production.

Starting with a single-wire output, 5V switched on and off, smoothed a little, and fed into an amplifier, no-one was left in any doubt as to the apparent ease with which Space Invader effects could be produced. Indeed, the BBC's Radiophonics Workshop could not have done much better.

Then Petsoft's Audio Calculator gave an intelligible speech output — amazingly still from a single-wire digital output. The addition of a ladder network gave an eight-bit converter for analogue output; though Händel may not have approved entirely, the four-part harmony was certainly melodious.

The Audiogenics Visible Music Monitor showed a four-part score as the music was played. David Annal reckons that he knew hardly anything about music before starting with these programs.

Vernon Gifford, chairman, is one of the main driving forces behind the club's activities. He is quietly spoken, sincere, with a properly measured enthusiasm and a keen intellect. One wonders how he finds the time for all that he achieves; he also does a good deal of work for the Association of London Computer Clubs, the Amateur Computer Club and the BCS.

He and David Annal are closely involved with the organisation of the fourth London Computer Fair which will be held at the North London Polytechnic at Easter.

One of the Special Interest Groups of Croydon MCC is working to develop computer aids for mentally-handicapped, Downs' syndrome children at a school in Selhurst, in the north of the borough. These children cannot work a keyboard so the programs have to use simple input and output.

Necessary work

For example, there are games where the children recognise shapes like street signs, or press any key the number of times that an object appears on the screen so as to learn to count.

The use of a Nascom and voluntary labour keeps costs to a minimum. Precious little funding is available for what seems to be very necessary work such as this.

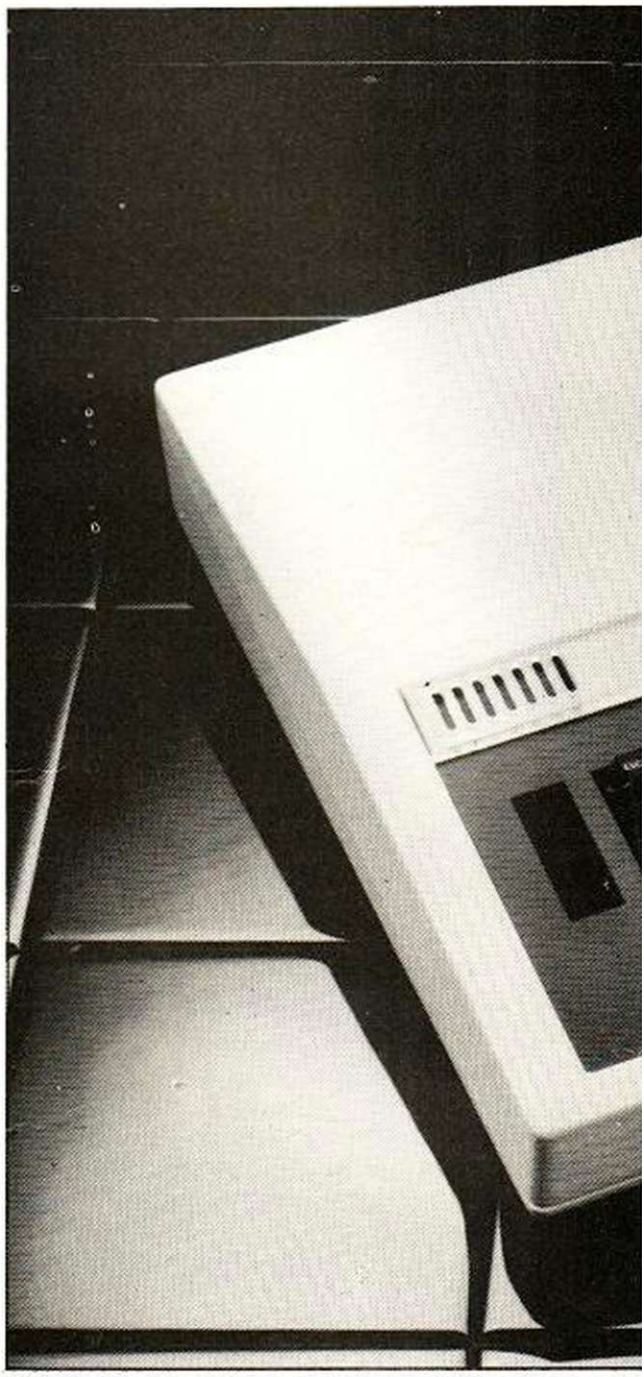
One group organised by the club is on Saturday morning and the second takes place on Monday from 4.30pm to 7pm for more advanced teenagers: Vernon Gifford takes an active part in both. David Johnston is the junior secretary, keeping track of membership and helping with administration.

The reckoning is that these computer groups are a vital supplement to computer studies in schools — they provide an opportunity for hands-on experience which is hard to find at a school with only one computer for several hundred pupils. ■

Computer Club is here to encourage you to start your own local computer club or, if one already exists, to join it and become involved. Each month we will devote the page to new ideas from local clubs. We would like to hear of anything which has made a club a success, or of any projects or programs you are developing.

REVIEW

THE BBC MICRO



Predicted sales of the BBC Microcomputer have mushroomed from an original estimate of 12,000 to possible orders of 100,000 during 1982. Tim Hartnell assesses one of the first of the £225 systems to leave the production line.

THE BBC MICROCOMPUTER is a joy to use, with flexible colours and an incredibly fast Basic of its own which has more facilities than you are ever likely to use. I must qualify this glowing praise by pointing out that the review machine was a pre-production model. One may take for granted that some of the facilities it lacked will be present in the commercially available model.

The BBC Microcomputer looks, at first sight, like an extended Atom, with a broader area behind the keyboard. There are 10 user-definable function keys at the back, but no separate numeric pad. The keyboard is very sensitive, like a good electric typewriter — as the BBC specification demanded — but the model I used was almost too sensitive and led to inadvertent double-striking time after time. The keyboard means touch-typists can program as fast as they can type, but I feel Acorn have overdone the sensitivity a little.

The processor is a 6502A, operating at 2MHz. The review computer was running at half speed, but was still extremely fast. When I converted one of my Life programs, written in Basic and which takes about 20 seconds a generation on the ZX-81, about four seconds a generation on the Atom, I found it took about 1.5 seconds on the BBC machine — speed indeed.

In a more formal test of the machine's speed, I ran a simple loop — count from zero to 1,000, printing out each number during the loop — on the Atom, the MZ-80K in Basic and in Pascal, and on the BBC machine. The result were:

- Atom — 1 minute 23 seconds
- MZ-80K, Basic — 50 seconds
- MZ-80K, Pascal — 22 seconds
- BBC Microcomputer — 14 seconds

The Atom time is so bad because the routine to Print takes a good deal of time-consuming care to keep the display snow-free.

The BBC Micro's Basic ROM occupies 16K, and the machine operating system a further 16K. The BBC says much of its software will call up monitor routines. There are two computers in the range, model A, which will sell for around £225, and the more flexible model B — around £335. The review machine was a model B.

The 73-key keyboard has the full QWERTY layout, the user-definable function keys, four cursor-control keys in the top right-hand corner marked with arrows, two-key rollover and auto-repeat.

The display is very flexible, but I feel the designers have made some very peculiar decisions. There are eight display modes, with zero to three available only on the more extensive model B. The graphics modes are:

Mode 0: High-resolution — 640 by 256 — two-colour graphics and 80-by-32 text.
Mode 1: High resolution — lower, in fact, 320 by 256 — four-colour graphics and 40-by-32 text.
Mode 2: 160 by 256, 16-colour graphics and 20-by-32 text. This is where I feel one strange decision has been made. The only mode which gives access to 16 colours has a very broad text of 20 characters across which is almost unreadable without a full blank line between each line of text The colours in mode 3 are superb and because of the wide range, this is the mode most model B owners will probably prefer. After all, 160 by 256 for graphics is an acceptable degree of resolution. Yet because the text is so broad — is it designed to be read at the back of classrooms? — the use of mode 2 will be somewhat restricted.
Mode 3: 80 by 25, two-colour text.

Model A supports only modes 4, 5, 6, 7 which are also, of course, supported by model B. The additional modes are:

Mode 4: 320 by 256, two-colour graphics and 40 by 32 text.
Mode 5: 160 by 256, four-colour graphics and 20 by 32 text.
Mode 6: Two-colour text.
Mode 7: Standard teletext display.

The colours you obtain in the two-colour mode are either black and white or certain pairs which you can call up with a command called VDU. The four colours are black, white, orange and yellow, but these can be changed using VDU.

The text, except for the broad mode 2, is very clear, with added extras such as a true ½ and ¾, plus little arrows, lambda, square root, a proper division sign and "approproximately equal to". The character set can be easily redefined using the VDU command. The character set, with a few of the control characters, includes:

Code	Result
12	Clear screen and home cursor
30	Home cursor without clearing screen
31	Move cursor to specified location — used as PRINT CHR$(31),X,Y
157	Reverse colours of a single line
48 to 57	Numbers 0 to 9
65 to 90	Upper-case letters A to Z
97 to 122	Lower case, with true descenders
255	Solid square, size of one character

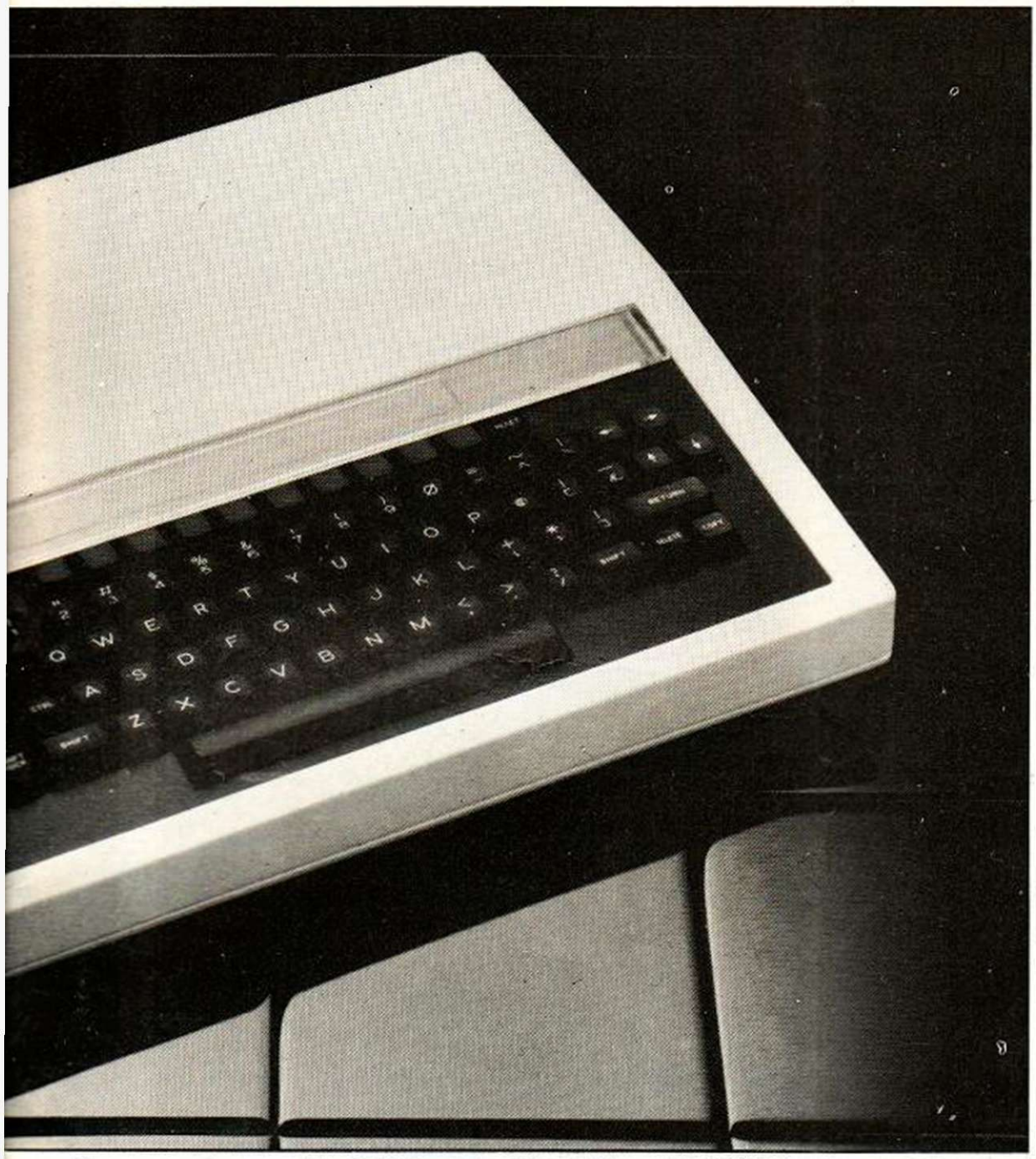
The review computer was feeding a monitor, so the colours were a little brighter and clearer than they will be on a domestic television. I tried the machine on my own television, and found that although there was a degradation compared with the monitor, the result was still perfectly satisfactory. The lower-case letters in mode 0 are, however, very difficult to read, except on a large television. Mode 0 puts 80 characters across a single line.

Room for expansion

The computer contains a three-tone music generator, which has the full envelope control of attack, sustain and decay, and which feeds an internal loudspeaker. The machine emits a quiet "beep" when you turn it on.

Model B is, as expected, far more flexible than the model A, and is equipped with a variety of I/O ports. There is a user eight-bit parallel input/output port, and four analogue inputs for games, paddles or control applications.

One of the real strengths of the Atom is the way it was designed as an opened-ended system, to accept a large number of peripherals. The BBC machine follows this lead, with room inside the case for adding such things as interfaces for floppy discs,



Econet or the cartridge ROM packs. A speech-sythesis unit will be available which will also fit within the case.

There is also space for a "tube" connector for connecting a second processor. The BBC computer is designed so it can be expanded to run with a second processor and considerably expanded memory.

All the units which will connect via the tube are still in the development stage and will not be available for some time. The BBC says the units will include a 3MHz 6502 processor with 60K of RAM, a Z-80 processor with 60K RAM running CP/M, and 16-bit processor with 128K RAM.

From these plans it is clear that the BBC Microcomputer has been designed with an eye to the future, to ensure it does not become obsolete quickly.

The second 16K language ROM contains a 6502 assembler along with the Basic, as does the Atom ROM, so Basic and assembler may be mixed within a program. There is space within the computer for up to four 16K language ROMs which are paged. ROMs under development include Pascal and a word processor.

The teletext display has all the features of standard teletext, including flashing and the double-height option.

The error messages are unambigious and polite — what else could we expect from a BBC machine? The error messages, in upper- and lower-case letters, include:

- Missing, at line 100
- Syntax error at line 100
- No such line — if you try to Goto or Gosub without a destination.

These are of great aid in debugging, as are Trace On, Trace Off, Trace X and Trace line-number.

The BBC machine shows evidence that a great deal of thought has gone into its creation, and demonstrates that Acorn has learned much from its experience with the Atom. Atom thinking permeates the machine, but the BBC machine design has weeded out the more idiosyncratic features of the Atom without sacrificing speed and flexibility.

The most notable hangover from the Atom is the use of the query "?" for Peek and Poke; its context determines which it is. For example, in the following Basic statement

```
IF ? A = 9
```

suggests Peek, while

```
? A, 98
```

indicates Poke.

There are some very useful features to save programming time. These include Auto which automatically numbers lines, starting at 10 and incrementing by 10 unless another option is chosen. Renumber, used as a direct command, is virtually instantaneous, and renumbers Gotos and Gosubs as well as the line numbers. Unless another option is specified, Renumber starts at 10 and increments in tens.

Those familiar with Atom Basic, and with some other implementations of the language, will be pleased to find the BBC machine accepts the same abbreviations for keyboards as the Atom, such as

P.(PRINT) R.(RETURN) L.(LIST) G.(GOTO).

Many first-time computer users are understandably bewildered when they first unpack and connect up their new toy. Unlike a record player or a television, a computer generally does not do anything at all, and certainly never does anything impressive unless it is told to do so.

Friendly manual

The BBC provides a cassette of programs marked "Welcome" which contains routines to help you have the computer up and running from the moment you manage to wiggle the seven-pin DIN plug into place. The initial package includes the computer, a two-metre long aerial lead for the TV or monitor, a computer-to-cassette lead, the "Welcome" cassette and a very comprehensive and surprisingly unstuffy manual. The cassette contains 16 games, and demonstrations, including Biorhythms and Clock.

The user's guide is divided into four sections. The first part tells you how to connect up the machine, and includes some simple, but impressive, one-line demonstrations to show the flexibility of the graphics commands. The second part of the guide purports to be an introduction to Basic but, as the manual admits, is really too brief to be of much use for the absolute beginner.

The third section goes through BBC Basic, command by command, with sample program lines showing the command in context, and associated keywords. The associated keywords for Restore, for example, are Read and Data.

The final part of the guide is a meaty reference section, giving an outline of the operation of the built-in assembler, the machine operating system, and such things as a memory map. Further technical manuals are planned to expand the information.

CONCLUSIONS

- The BBC Microcomputer is a splendid machine, with many avenues for exploration.
- Acorn and the BBC have done their work well, producing a machine which is better than the market demands — it is even over-specified. By doing this they have ensured they will probably not be able to meet the demand for the machine once word travels as to how good it is.
- They have also ensured that it will not become obsolete quickly, and they have earned the undying hatred of every other manufacturer of £200 micros. ■

REVIEW

WORD PROCESSING ON

The low-cost Seikosha GP-80 printer coupled with WordPack can transform the Acorn Atom into a word-processing system capable of dealing with most applications outside the office. Norman Kirby reviews.

AT £230 INCLUDING VAT, the Seikosha GP-80 is the least expensive wide printer available. The Tandy Personal Line Printer VII is now about £10 more expensive and following it is the new, more sophisticated Roxburgh RX-8000-FF at slightly more than £250. The Tandy machine is made by Seikosha, but is a different model from the GP-80 — Tandy claims it is a more advanced one — and to interface it to non-Tandy computers requires an effort.

The GP-80 is available in three or four sub-models but it is not always easy to spot the difference between them. Some have European characters as well, and the standard interface is different. They all seem suitable in principle for most computers. I shall describe the GP-80M sold by Nottingham-based Leasalink Viewdata Ltd, the main distributors of all Acorn products, and others which can be used on the Atom.

Leasalink charges £232 for the printer including carriage and complete with a 3ft. ribbon cable, a plug and a socket to connect the printer and the Atom, 6ft. of mains cable and 100 sheets of paper.

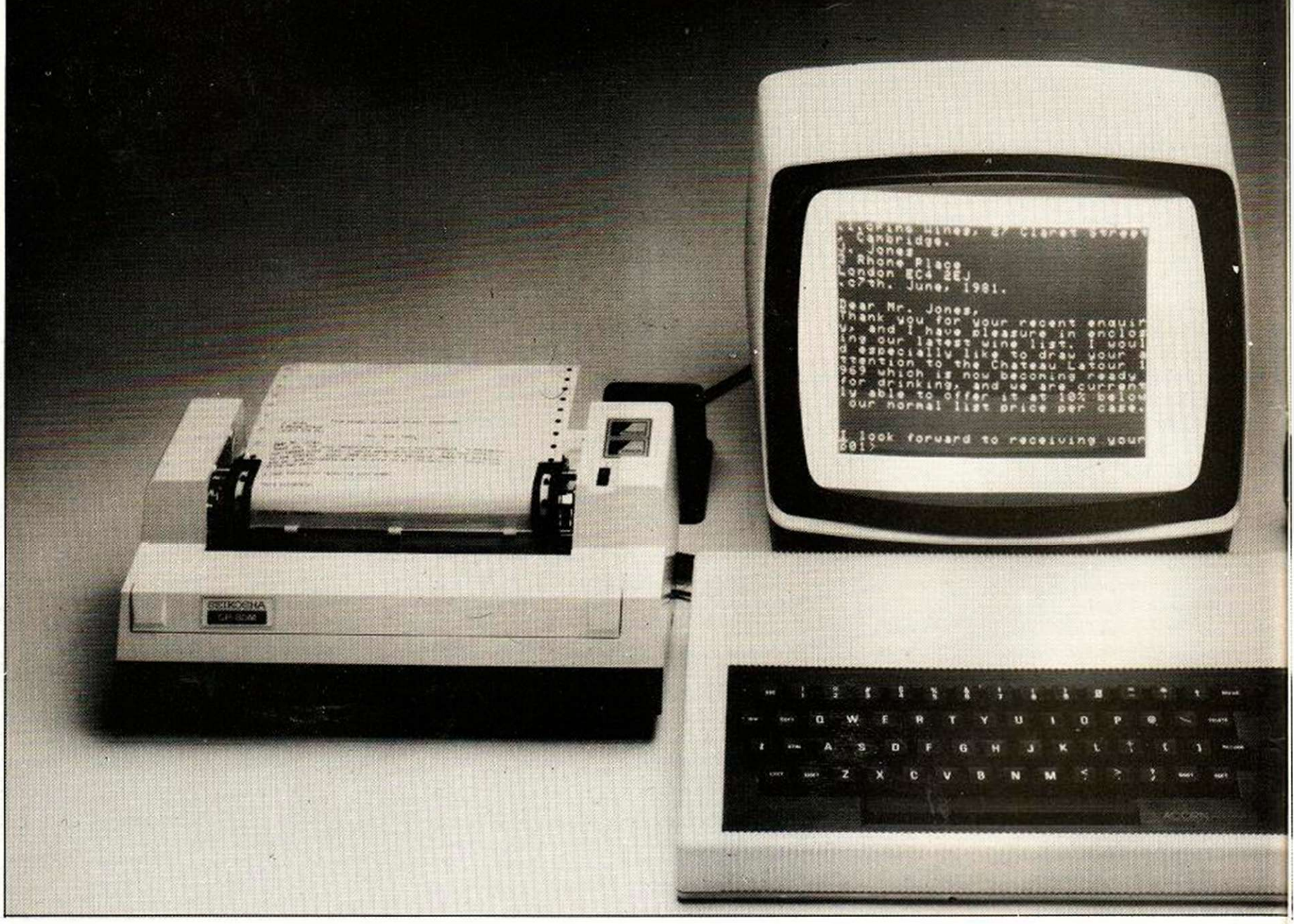
To prepare a minimal Atom, a 6522 versatile interface adaptor (VIA) and a LS-244 buffer must be plugged into the appropriate sockets already on the board. Also, you must solder a 26-way PCB plug on to the board as described in the Atom manual. A simple wire link needs to be soldered between two pins in the board — only a 20-minute job if you follow Leasalink's instructions. Use a soldering iron with an iron tip about 1mm. in diameter to avoid the risk of bridging pins. The VIA and buffer cost £10.35 but are, of course, available from many suppliers; the PCB plug costs £4.75.

Be careful when inserting integrated circuits into sockets: the pins are easily bent. I use a jeweller's eyeglass and inspect meticulously while the circuit slides home. The socket at the Atom end of the ribbon cable can be inserted the wrong way round. The cable should fall downwards when viewed with the Atom the right way up.

Printed result

The printer produces the full 96-character ASCII set and uses the common five-by-seven dot-matrix system. Like many other similar inexpensive machines, it cannot underline and does not print lower-case descenders. Underlining can easily be done manually; descenders cannot. This is, however, no problem and you soon grow used to them.

The printed result is very clear and neat with a satisfactory degree of uniformity. It is



not, perhaps, as sharp and clear as more expensive five-by-seven dot-matrix machines, but it is good.

To enable the printer, you must execute Print $2 either from the keyboard or from a program, or press CTRL and "B". Everything printed on the screen will go to the printer. To disable, execute Print $3 or press CTRL and "C".

The printer can also print double-width characters which, by an optical illusion, appear higher. The result is the appearance of a larger type-face which is very impressive for headings to, say, letters and tables.

To obtain this, you execute Print $14, and to cancel it, Print $15. It prints as fast as any home computer user could wish — 30 characters per second, with up to 80 characters per line. The average A4 sheet typed with a conventional typewriter in a small type-face fits about 70 characters into the line.

Fan-fold paper is available at about £8 per 1,000 sheets including VAT, plus carriage. That is a reasonable price although a little more than stationers' A4 paper. It is of adequate quality for most applications. The paper is 8in. wide with tear-off perforations every 12in. That is a little narrower and longer than A4 and the maximum width the printer can take is 8in. — the minimum is 4.5in.

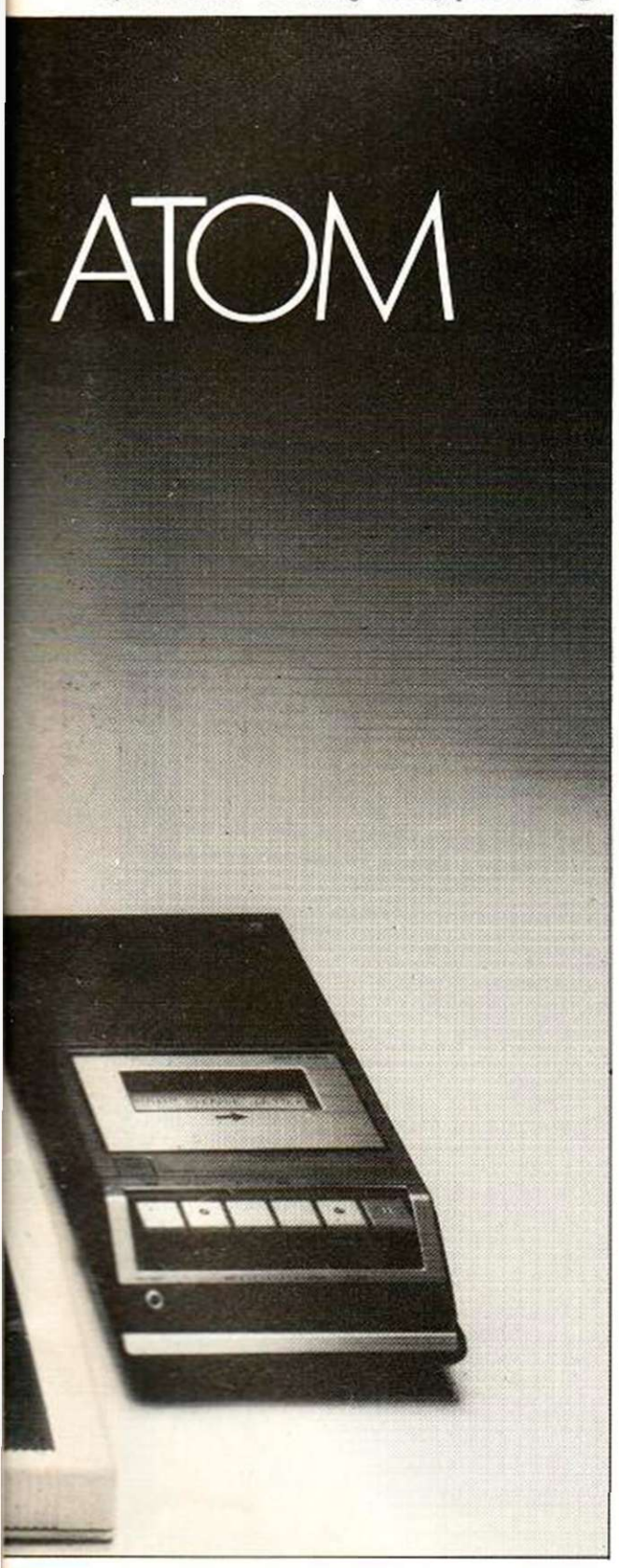
There are no perforations vertically along each side to allow removal of the sprocket holes but these can easily be cut off with a razor to improve the appearance of a letter. The copy paper available means you can obtain two duplicates simultaneously.

The paper is easy to feed in — aided by a feed-forward wheel — but I would have appreciated some way of moving the paper backwards without having to disengage and re-engage it. The ribbon is in a replaceable cassette. The manual is satisfactory.

The Seikosha can also print graphics. Since each dot is the size of a pinprick the resolution is very high. Leasalink supplies a medium-length assembler program to dump to the printer a full screen of Atom Mode 4 graphics. A screen holds 256 spots horizontally and 192 vertically.

You generate a screen of graphics in the usual way and, having previously assembled the dump program, Link to it — other computers would use USR. The graphics are then printed occupying an area of 3.6in. wide by 3.5in. high. It takes about three minutes. The Leasalink program prints the graphics in the middle of the page with a thin border but this software could easily be modified.

Briefly, a word processor is a keyboard, a screen, a printer and a memory store. It allows you to create and edit text on the screen. You can correct errors, change letters, words, sentences or paragraphs, and interchange passages, until you are satisfied. When all is as you require, you can obtain a printout of the text. Further alterations can be made after printing by amending only the parts to be changed, and reprinting. The whole page or document need not be typed again. The text following the change is respaced to allow for the insertion, or contracts after a deletion.



Novel feature

The Atom word processor, WordPack, costs £30 including VAT and is available from Acornsoft, Leasalink and several other dealers. It is a 24-pin ROM which fits into the spare utilities socket provided on even the minimal SK-24 Atom board. A novel feature is that the top of the ROM has a small transparent window through which you can see the chip.

The Atom will continue to operate normally but will accept two new commands — Edit and Text; the first spawns 43 further instructions. The advantage of a ROM over a taped or disc program is, first, that the ROM does not use precious RAM, and secondly, there is no time-consuming loading — not such a significant plus if you have a disc.

To use the WordPack, execute Edit and the screen will clear as for Mode 4 graphics. Answering the prompt "Old text?" produces a rectangular end-of-text marker at top left with p01> at bottom left. That means "page 1" followed by a prompt. Type "e" and enter some text. Press Copy and it will be deleted and transferred to the top of the screen. The keyboard works just like a normal typewriter, with upper- and lower-case letters selected by Shift.

If you continue to enter text, it is transferred to the top of the screen from time to time in blocks of up to 488 characters. When you want, the text at the top can be edited. There is an underline-type cursor which can be moved using the normal cursor-control keys. Position it under a character, press delete, and it will disappear. If you press "i" and a single character key, that character will be inserted immediately before the cursor.

Press "x" for exchange and a single character key, and that character will be exchange for the one above the cursor. Alternatively, if you press "a" and enter a passage of text up to 488 characters long, press "copy", the passage will be inserted immediately after the cursor. By pressing "b" the same can be accomplished before the cursor.

Another editing technique is to move the cursor to the start of a piece of text which needs attention. Press "@", move the cursor to the end of that piece, so marking it. You then can either press Delete and the marked piece will disappear or press "r", enter a passage of text, and press Copy. The new passage will replace the marked piece. Alternatively, press "t" for transfer and the marked piece will be deleted and stored in a temporary buffer.

Powerful command

Using the "a" or "b" operation described will then insert it in another place of your choice in the text. In this way sentences and paragraphs can be repositioned. The displayed text can be paged forward and back using single keystrokes, and it can be scrolled up.

A powerful feature is the find-and-replace command. You can ask WordPack to find and present a specific word or string of words each time they occur. Equally, you can ask WordPack to substitute another word or string of words. After examining each individual instance, you decide whether it should be replaced, or you can specify that it should be replaced throughout the text.

This command allows you to correct, say, a certain spelling mistake you have discovered. It also allows you to use abbreviations to save typing: when the text is complete, you replace each abbreviation with the full word — for example, "b.s." could stand for building society.

Because a computer program can be edited just like text by using the Text command, spaces can be eliminated and fully-written commands can be replaced by their abbreviations — Goto replaced by "G".

You must, of course, include commands for indentation, lines per page, page numbering, justification or not, single or double spacing, automatic centring or not of individual lines, preventing a table or list being split between two pages, starting a new page, stopping printing for a new piece of paper — if you are using single sheets — and printing in single or double-width characters. You can also set the right-hand margin.

These commands take the form of a full stop followed by a lower-case letter, and must be

(continued on page 21)

CASTLE ELECTRONICS
COMPUTER SUPERMARKET
Telephone Hastings [0424] 437875

VIC 20 COLOUR COMPUTER

* graphics character set
* plug-in programme/memory cartridges
* colour * sound
* programmable function keys
* 5K memory expandable to 32K
* standard PETBASIC
* full-size typewriter keyboard
* low-priced peripherals
* joystick/paddles/lightpen
* self-teaching materials

ONLY £189·95

Cassette Deck now available - £44-95

Acorn Atom BRITISH DESIGNED PERSONAL COMPUTER

8K ROM + 2K RAM Kit. .	£140-00
8K ROM + 2K RAM Ass. .	£174-50
12K ROM + 12K RAM Kit. . .	£255-00
12K ROM + 12K RAM Ass. . .	£289-50
4K Floating Point ROM.	£ 23-00
Colour encoder. . .	£ 21-85
Mains Power Supply.	£ 9-20

FROM £140

FREE POSTAGE AND PACKING ON ALL CASH/CHEQUE/P.O. ORDERS

ATARI COMPUTERS FOR PEOPLE

Model 400 16K. . . .	£345-00
Model 800 16K. . . .	£645-00
Cassette.	£ 50-00
Disk Drive	£345-00
80 Col. Printer	£550-00

Plus All Accessories Available.

TANGERINE microtan

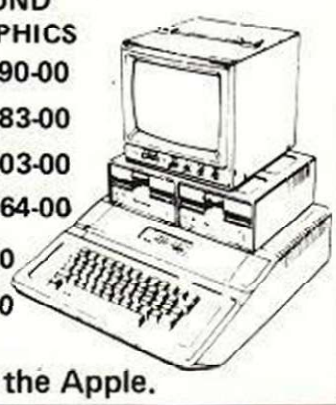
Microtan 65 Kit . . .	£79-35
Microtan 65 Built . .	£90-85
Tanex Min. Config. Kit. .	£49-45
20 Way Keypad	£11-50

TANTEL PRESTEL ADAPTER – £199.00

We hold a complete stock of all the Tangerine equipment. Send SAE or 'phone for details.

apple® computer

BUILT IN SOUND
HIGH RES. GRAPHICS



Apple II Plus 48K	£790-00
Disc Drive + Controller. . . .	£383-00
D.D. without Controller . . .	£303-00
Pascal Card.	£264-00
Eurocolour Card	£ 73-00
Hitachi 9" Monitor . . .	£146-00

We stock all the goodies for the Apple.

COMMODORE PET

8K PET	£458-85
16K PET	£550-00
32K PET	£599-00
Dual Disc Drive . .	£799-00
Printer.	£454-25
External Cassette.	£ 63-25

Complete range PET equipment in Stock.

CASSETTE SOFTWARE: Strathclyde Basic Course, Basic Basic Course, Invaders, Treasure Trove of Games 1 to 10 (10 selections of games), Basic Maths, Algebra, Statistical Packs and lots more!

SPECIAL OFFER – 20% OFF ALL nascom PRICES.
IMP PRINTER NOW £230. PHONE OR WRITE FOR DETAILS.

C.B. RIGS

MAKE: DNT 27 MHz FM. MOBILE 4 WATTS, 40 CHANNELS. STRICTLY ACCORDING TO GOVERNMENT SPECIFICATION. ONLY **£98.25.** SEND SAE FOR SPECIFICATION

ALL PRICES INCLUDE VAT. VISA **ACCEPTED. ORDERS NORMALLY DESPATCHED DAY OF RECEIPT.**

CASTLE ELECTRONICS 7 Castle St., Hastings, E.Sussex
shop hours 09.00~17.30 Mon~Sat
personal callers welcome

(continued from page 19)

placed at the beginning of a line. For example, ".i10" means indent 10 spaces until further notice; ".160" means 60 lines per page, ".o14" means print double-width characters until further notice and "o15" cancels that; ".t4" calls for an indent of four for that line only. They default to the most convenient arrangement if no command is given.

Text can be saved to cassette or disc and loaded without interfering with the display, and the commands are a simpler version of the usual ones. Pressing "w" will give the address of the first free memory location after the text, allowing the *Load command to append a further file of text on the end.

Acornsoft's high-speed cassette-saving and loading program can be used to speed up these processes. The Atom's highly-reliable loading is a boom. A saved file can, of course, be loaded and amendments made, then printed. The only typing involved is that for the actual amendments.

The only significant omission I can find is the lack of a tabulation command. Acorn says that it will be releasing a cassette which contains software to add that facility together with the ability to print a title repeatedly on each page. Acorn is also producing a disc system for the Atom at about £299.

The memory requirements are 6K of RAM in the upper text space for displaying the text, and whatever you have in the lower. The text starts at location # 2800 if the floating-point ROM is fitted, # 2900 otherwise. Here 5K will hold the equivalent of three A4 pages of conventional single-spaced typescript using a medium-sized type-face. The Atom can hold up to 21K in this area. Larger documents can be split and entered, processed, saved and printed as consecutive sections.

It is acceptably crashproof. Acorn has ensured that nearly all invalid key strokes are ignored. However, I have managed to crash it a few times. Usually, pressing Break, executing Edit, and making a minor repair to the beginning of the text effect a recovery.

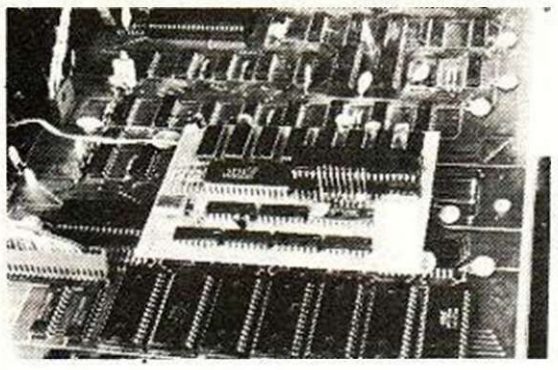
WordPack is a delight to use and I never want to touch a conventional typewriter again. Of course, £30 will not turn your Atom into an expensive, office-type word processor, but you have the essentials. It is definitely a serious package and in no way a toy.

It is useful for letters, club membership and fixture lists, leaflets, articles, recipes, reports and circulars. It is worth considering for office use — the whole cost of an Atom, printer and ROM is slightly more than £550 including VAT but excluding a cassette recorder and TV or monitor. It would be pointless, however, to consider it without a printer.

CONCLUSIONS

- The Seikosha Printer at about £230 including VAT, ribbon cable and some paper is the least expensive wide printer on the market, and it should interface easily to most computers.
- It prints all 96 standard ASCII characters in a five-by-seven dot matrix but lower-case letters do not have descenders. Double-width characters can be printed.
- The printed result is neat and attractive and can be used for letters although it is not, of course, as good as expensive letter-quality machines.
- It can also print graphics which, at least with the Atom, are very attractive. With each dot the size of a pin-prick, the resolution is very high.
- With a printer, the £30 WordPack ROM turns the Atom into a thoroughly practical tool for the home, club and also the small office. The ROM plugs into the spare utilities socket on the Atom board. The computer works normally but WordPack is instantly available on executing one command.
- Computer programs can also be edited and transferred to the upper text space for running.
- All the really essential facilities of word processing are available. The only significant omission is the ability to specify tabulations. However, Acorn is producing software on cassette to add this and repetitive page headings.
- The word processor is a delight to operate and makes the conventional typewriter seem an anachronism. It is good value for money. ■

RAM EXPANSION for 6502 and Z80A Micros



ATOM — PET — UK 101/O.S. — TRS 80 — VIDEOGENIE and ZX81

Prices:

Expansion module	Atom	Old Pet	New Pet	UK/OS	TRS80	Videogenie	ZX81
16K	£40	£40	£40	£40	£33	£33	£33
32K	£52	£52	£52	£52	£45	£45	£45
64K	£80	£80	£80	£80	£73	£73	£73
128K	£130	£130	£130	£130	£123	£123	£123

Prices shown are for kit versions. Please add £8.00 + VAT to all prices for ready-built modules.

All prices include full components and documentation. Please add 15% VAT.
*Extra power supply of 12V/1A and −5V/10mA required. You can either provide it yourself or we can supply it for you at £8 + VAT.
Think of the future . . . and then get down to the basics.
The power of your Microcomputer really lies in its software — and the power of its software depends directly upon the availability of Ram.
Memory modules are now easy to install and low cost. So why wait?
We have designed memory modules for the PET, ATOM, UK101/OHIO SUPERBOARD, TRS80, VIDEOGENIE and the ZX81. Off the shelf and ready to run. In most cases, simply plug into the 40 pin socket of your Microprocessor and you get 128K, 64K, 32K or 16K more RAM at your fingertips.
How do we do it?
We make the latest device in the field available to everyone — the Motorola MC 6665 L20 or 64K bit on a single chip, which consumes a mere 10mA at 5V to retain your data or programs. We put eight of this on to a board the size of a cigarette packet to give you eight times the actual power of your Microcomputer.
If you do not yet know how to make full use of your 64/128K, our latest documentation includes programming examples to start you off.
Please write or ring us for further details:

AUDIO COMPUTERS, 87 BOURNEMOUTH PARK ROAD, SOUTHEND-ON-SEA, ESSEX
TEL: 0702 613081

MICRO GEN QUALITY PROGRAMMES

ZX81 CHESS

LOOK AT THESE FEATURES
- ★ Graphic display of positions on chess board
- ★ Displays separate record of your move and the computers
- ★ Written in superfast machine code
- ★ Plays all legal moves including castling and enpassant but if an illegal move is entered will answer illegal move
- ★ Six levels of play
- ★ Random weighting computer doesn't always play the same move in an identical situation
- ★ Board can be set up to any configuration and you can even alter or exchange sides in midgame
- ★ Amazing power in 10K of memory

PLUS CHESS CLOCK!
- ★ Records and display time taken per player
- ★ Resetable function
- ★ Single key entry

ONLY £9.50 + 40p P & P

ZX NEW YORK

Can you bomb and blow up your targets before your plane loses altitude and crashes

- ★ Superb Graphics
- ★ Superfast Machine Code
- ★ Score continuously incremented
- ★ Displays highest score of previous games
- ★ Simulated bombs and rockets

ONLY £4.50 + 40p P & P

Cheques made payable to: **MICRO GEN DEPT YC**
24 AGAR CRESCENT, BRACKNELL, BERKS

Sinclair ZX81 software

INVADERS!

Fast-moving, machine code version of the famous arcade game, for the 16K ZX81. Shields are provided to help protect you from the bombs of the marching aliens. Ten levels of play, from easy to suicidal! On screen scoring.
PRICE ONLY £4.00

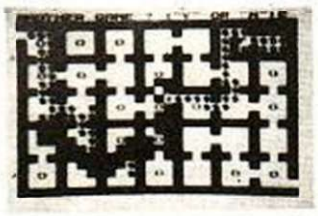
STARTREK

The classic computer game in which you trek across the galaxy in search of Klingons to zap with your phasers and photon torpedoes. You have long and short range scanners to help you find them, Starbases to refuel your ship at and, of course, various witty comments from the crew.
PRICE £5.00

ADVENTURE

An adventure program entitled : THE DAMSEL AND THE BEAST
A Game of concentration and suspense in which you, the intrepid hero, must wander in the darkness and dangers of the Beast's palace, find the Damsel hiding or imprisoned there, kill the Beast, and then last but not least, lead the Damsel to the palace exit before she starves to death. There is an "easy" (?!) version for L-plate heroes, a medium game for the experienced adventurer, and a difficult game for the suicidal. An extremely complex, frustrating and entertaining game.
PRICE ONLY £6.50

NEW



1K BREAKOUT

Two versions of the popular arcade game, both written in machine code, and [illegible] into the 1K ZX81. Flicker-free, fast moving graphics.

ZXAS

Full machine code assembler for the ZX81 & 8K ROM ZX80 (16K) complete with documentation.
ONLY £3.95

ZXDB

Machine code disassembler & debugging program — can be used with ZXAS. Many useful utilities. For 16K ZX81 & 8K ROM ZX80.
ONLY £5.95

MULTIFILE

An amazingly versatile multi-purpose filing system for the 16K ZX81. The program is menu-driven, and number, size and headings of files are user-definable. Both string and numerical files are catered for. Files may be created, modified, replaced, and searched, and are protected by an ingenious foolproof security system. Output to the ZX printer is also provided. The program comes on cassette, together with three quality data cassettes for file storage, and comprehensive documentation, describing a host of applications for both business and personal use. If your ZX81 is bored with playing games, then this program will give it plenty to think about!
PRICE £17.50 INCLUSIVE
DOCUMENTATION ONLY - £1.00 (refundable).

NEW: VIEWTEXT

A ten page information display system for the 16K ZX81. Can display both text and graphics in any sequence with variable speed. Many applications including shop window displays, education, animation, etc.
PRICE £7.00

PROGRAM PACK 4 for 16K ZX81

Two highly entertaining and addictive games for the expanded ZX81, written in machine code with very fast moving graphics. ASTEROID BELT and SURROUND (2 versions)
BOTH PROGRAMS FOR ONLY £4.50

PROGRAM PACK 6 for the 16K ZX81 & 8K ROM ZX80

Two programs for the expanded ZX81 to keep you entertained for hours! 3-D OXO is written in machine code, and is hard to beat. The other is a compulsive adventure game called MARS RESCUE.
BOTH PROGRAMS FOR ONLY £4.50

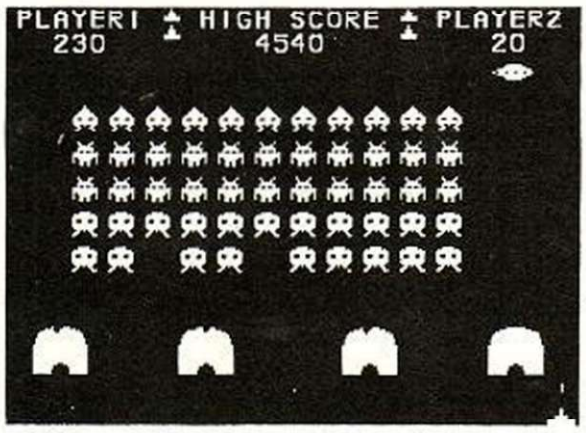
VISA

ALL PRICES INCLUSIVE
TELEPHONE 051 227 2642

BUG-BYTE
Microcomputer Software
98-100 THE ALBANY
OLD HALL STREET
LIVERPOOL L3 9EP

BUG-BYTE

Acorn Atom INVADERS



"The best excuse to expand your Atom. It is a superb version of the standard game, tough and fast" *Your Computer* Nov '81
12K, graphics mode 4 **ONLY £8.00**

Acorn Atom CHESS

THE PROGRAM YOU'VE BEEN WAITING FOR!
Fantastic machine code chess game for the 12K Atom. Features include: split screen (high res. + alphanumerics); many levels of play; castling & en passant; computer plays black or white; can set up pieces for chess problems etc. Supplied on cassette with instructions. **PRICE ONLY £9.00**
DON'T FORGET — OUR PRICES INCLUDE VAT & POSTAGE

Acorn Atom FRUIT MACHINE

"A brilliant, incredibly fast model with lovely sound and graphics" *Your Computer* Nov '81
8K, graphics mode 2. **ONLY £4.00**

MORE ATOM CASSETTES FROM OUR RANGE

PINBALL 6K, gr. 2	£6.00
BACKGAMMON 7K	£7.00
BREAKOUT 4K, gr. 1	£4.00
STAR TREK 12K, FP	£5.00
LUNAR LANDER 12K, gr. 4	£5.50
LABYRINTH 12K, gr. 2A, FP	£7.00
GOLF 7K, FP	£5.00
NEW 1-key BASIC 2K	£5.00
STOCKMARKET 5K, FP	£5.00
DODGEMS + SNAKE 6K	£5.00
DISASSEMBLER 2K	£4.00
TYPIST 7K	£4.00
UFO BOMBER 7K	£4.00

747

FLIGHT SIMULATION PROGRAM FOR THE 12K ATOM

Written for Bug-Byte by a 747 pilot. Accurate simulation of a 747's cockpit display (airspeed, altitude, rate of climb, attitude, flaps, etc., and graphic display of horizontal situation & attitude); allows you to guide your craft to the landing strip. On making your final approach the display changes to a high-resolution 30 representation of the runway coming up to meet you. A real test of skill. Finding the runway is quite a challenge — landing safely is even more difficult. If you succeed, you are awarded a skill rating and the chance to take off and try again.
REQUIRES FLOATING POINT ROM **PRICE ONLY £8.00**

ALL OUR PRICES ARE INCLUSIVE!

Please cross cheques/POs and make them payable to "Bug-Byte". Payment may be made by Access or Barclaycard, and there is a 24hr answering service on 051 227 2642

VISA

BUG-BYTE
Microcomputer Software
98-100 THE ALBANY
OLD HALL STREET
LIVERPOOL L3 9EP

BUG-BYTE

INTERVIEW
KENNETH

In January 1981, Kenneth Baker MP became the first Government Minister with responsibility for Information Technology — an all-embracing term covering everything from space satellites to Sinclair ZX-81s. He talks to Duncan Scot about his hopes for reversing Britain's decline and his plans for the future.

KENNETH BAKER IS the force behind the designation of 1982 as Information Technology Year, the year the Government hopes to use its considerable propaganda skills and power to push a new message across to individuals and industry. That message is that unless we use new technology now, our living standards will not only lag behind those of our industrial competitors but will, for almost the first time in centuries, stagger into absolute decline.

Kenneth Baker had a conventional background for a Conservative minister. He was born in 1934 and educated at St Paul's and at Magdalen College, Oxford. During his national service, from 1953-55, he was a lieutenant in the Royal Artillery in North Africa and also an instructor to the Libyan Army. During his time at Oxford from 1955-58 he was Secretary of the Oxford Union.

Soon after Kenneth Baker first entered Parliament he was described as a Peter Walker clone, articulate, fond of satire and casual in his dress, although only by the austere standards of Conservative ministers. He is also something of a rarity in that he is often billed as a minister who actually knows something about his subject.

"Although I have been involved in computing for some time I am not a trained computer man at all — I studied history at Oxford. When I came down in 1958, I moved straight into general management working for several companies. In the early sixties I ran companies, groups, sometimes public groups, working very much to pull them round.

"Doing that I discovered the advantages of using computers. This was in the very early days of computers, but there were definite advantages in doing jobs like payroll and simple stock control."

In the meantime, he was working hard within the Conservative Party. He served on Twickenham Borough Council from 1960-62 and contested a number of elections before finally entering Parliament in a by-election in March 1968 as member for Acton.

"It was when Wilson was at the absolute trough of his popularity — I won the by-election in an even bigger swing than the SDP did in Crosby in November. So I won a Labour seat in 1968 but it went back to its rightful home in the general election in 1970. Then I won a by-election in Marylebone three months later. I was very lucky to have been given the first by-election to come up when Lord Hailsham became the Lord Chancellor. I think I have the record for the shortest gap between two seats.

"In 1972 I joined Ted Heath's Government as a junior minister in charge of the Civil Service Department where I found, among other things, the Computer Agency being set up. There were two things which particularly interested me then; they were the HMSO and the Computer Agency. I put management accountants into HMSO to try and turn it into a commercial operation. It takes a long time for those kinds of thing to happen.

"I also ran the Computer Agency and took a very considerable interest in that. It was really a buying agency for the Civil Service. The particular policy I followed, and it was well known at the time, was to increase the amount of business being pushed out to the software houses of Britain and giving every little bit of encouragement along that particular road".

Kenneth Baker's present job must give him a certain sense of *déjà vu*. In 1972 he was involved in the then rescue of ICL, the State-backed computer company. In 1982 he found himself again responsible for trying

'Government should be co-ordinator and catalyst'

to push the company back on to the road to commercial viability. He was largely responsible for persuading the Government that it was worth another try with new management, rather than selling the company off to a foreign computer agency. ICL now has £200 million of Government guaranteed loans.

The Conservative Government was defeated in the general election of February 1974 and Kenneth Baker returned to the back-benches of Parliament and to business, spending more of his time as a consultant. As a Parliamentary Private Secretary to Ted Heath from 1974-75 he was regarded very much as a Heath man, an advocate of state intervention to support and help certain industries and was left out of the Government formed by Margaret Thatcher in 1979. He remained very active, however, writing numerous newspaper articles, making speeches and working within the Conservative Party and on various committees.

One speech he made in June 1980 is now seen as the turning point in his career. In effect, he detailed his own job specification. In the speech, at a business telecommunications conference, he outlined a "National Strategy for Information Technology" which included a 10-point programme. Many of the 10 points have now been sanctioned.

The first was the appointment of a Minister of Information Technology who would act as a focal point in Government for this diverse industry. He went on to demand that schools should be provided with small and low-cost personal computers and software systems and that British companies should be asked to design and supply these; that a national training programme in the new skills should be started at all levels, from schools to universities including both teachers and pupils.

As he said in his speech, "The opportunity in this country is immense and we must not let it slip between our fingers. It is a fiercely competitive industry. Since every developed country has reached the same conclusion, their governments have decided to involve themselves in promoting or protecting their own information-technology industry. The Japanese government, for example, has injected £1,100 million into the industry to catch up with America. I am not arguing for vast state intervention — the role of the Government should be that of co-ordinator and catalyst".

"I drew up the specification for

BAKER MP

this job and decided that as a country we had to pull together all the activities in this area. I was fairly critical, before I became the Minister, of most of the departments in the Government because I did not think they were putting their acts together. I was critical of the Department of Education because I did not think they were — they are now — really giving enough consideration to high technology. In all fairness, they had allocated £9 million very much for software development and teacher training, which is a very important part.

"The scheme I have introduced, Microcomputers in Schools, would not have been introduced without support from the Department of Education. I provided the catalyst. I provided the money for hardware for micros in schools. It is a very successful scheme and I am very proud of that. Slightly more than 3,000 secondary schools did not have microcomputers and we have already helped 2,000 of them — a great success story".

Under the scheme, the Government promises to pay half the cost of either a Research Machines 380-Z or

'I am very keen to promote British hardware'

a BBC Microcomputer for any school which does not already have any microcomputers. The other half of the cost has to be met by the school, the Local Education Authority or by parent/teacher associations. As from January 1, 1982 the scheme is being extended to those schools which already have some equipment. Independent schools have to apply through the National Computing Centre in Manchester.

Kenneth Baker is also planning to run a second Schools Computer Competition in which 100 computers are given away in prizes to those schools which submit the best essays describing how they would use a personal computer. Last year's competition attracted considerably more than 600 entries. This year more than 1,000 schools have indicated that they will enter.

He does not accept the view that there is no need to train the teachers. So many computer users now buy their computers mail-order and manage to teach themselves how to program, that some people are doubtful of the need to spend £9 million on training teachers. "That is splendid", says Kenneth Baker. "Clive Sinclair in particular is a marvellous man. He has really broken through with cheap personal computers. But if you are to put personal computers in schools and teach children you must have the staff to do it.

"On the other hand, some lovely stories have filtered back from some of the schools which have the personal computers. In one school one of the sixth-formers sat down and really mastered the school's personal computer and is now holding training sessions for the teachers".

Another of the well-known areas for which Kenneth Baker has responsibility is videotex, that umbrella term covering everything from broadcast teletext to British Telecom's Prestel service. The speed at which the British Prestel service has been adopted has fallen considerably behind British Telecom's published forecasts.

"I think Prestel has been slow", says Kenneth Baker, "because British Telecom went for the domestic market, and the domestic consumer is often, quite justifiably, worried about the extra cost. I can see why British Telecom wanted to go for that market. There are many unused telephone lines outside business hours.

"Yet Prestel is taking off now in private viewdata systems. There is no question about that. We have tried to pull the whole thing together. Last year has been a considerable breakthrough so far as teletext is concerned. The Teletext Month in October 1981 was a great success. Something like 20 percent of the sets sold, I am told, have a teletext facility. People are now used to seeing screens with information on them. This is something of a breakthrough in familiarisation. I hope by the end of 1982 there will be at least a million sets installed with full teletext facilities. I would hope that by 1984-85 virtually every set which is sold will automatically have teletext facilities.

"The Prestel side will, I think, take just that much longer to get off the ground. As far as the consumer is concerned, teletext is just another button on the television set. If you have Prestel it is telephone time you

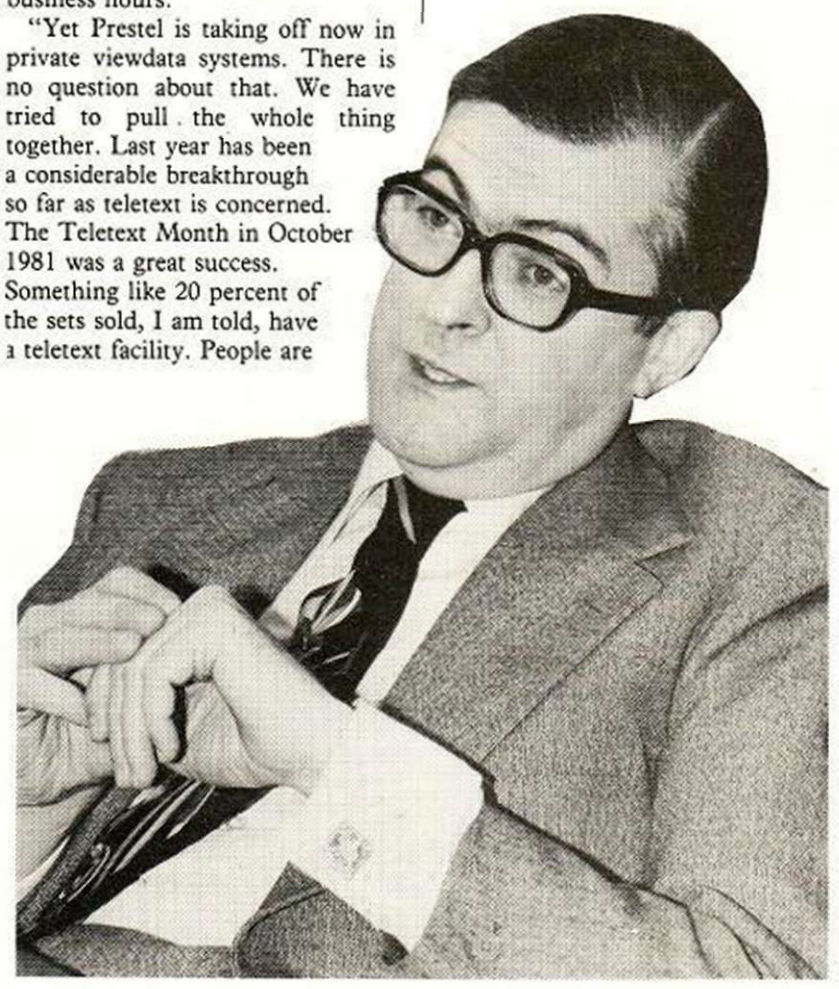
'A breakthrough in familiarisation'

are using and most people reckon that that is expensive, which it is".

Kenneth Baker was unaware of the scale on which British-made Prestel adaptors, such as the Tantel unit, are being produced. He thought that most adaptors cost about £200 and were imported from abroad. "You have drawn my attention to the Tantel and it sounds very interesting. I will look into it. This is the kind of thing I am looking at to see if I can give some assistance in one way or another — through trade not aid.

"I am very keen to help promote British hardware products. The Micros in Schools scheme has done very well with the Research Machines 380-Z and the BBC Microcomputer".

The full range of Kenneth Baker's responsibilities extend somewhat beyond personal computers. He has



persuaded the Government to declare 1982 Information Technology Year. This has been criticised by some commentators as just bringing together various existing Government initiatives, from satellites to personal computers, under one title.

"That is very unfair. There are many projects I have announced which I do not believe would have been possible to get off the ground without focusing attention on the whole of the information-technology area. The importance of Information Technology Year is that we are putting it into high profile. Several of the projects I have announced would simply not have happened had I not done this. For example, the Information Technology Centres and I am doubtful if the Schools Scheme would have happened otherwise.

"I think this is probably the only government in the world which has actually pulled the threads together under one administrative head. We no longer have a myopic view of each industry. I also have a unit at the Cabinet Office, under the Home Secretary, which co-ordinates Government activity in this area. I also have six independent advisors. None of this would have happened unless we had made it happen.

"To believe that a thousand flowers will just pop up all by themselves without fertiliser, without the propagation of seeds is a little naive".

All the same, Kenneth Baker accepts that the Government has appeared on the scene a little late in the day, now that the personal-computer industry is firmly established with up to 300,000 microcomputers already in use and with the industry flourishing under its own entrepreneurial momentum. "I would not disagree with that", he says. "I think that all governments tend to come into the act late in the day".

Other Government initiatives for IT '82 include the L-SAT telecommunications project for which the U.K. is to put up a third of the cost, amounting to £77 million; a major system for reading electricity meters remotely via the mains; the creation of a nationwide network of Microsystem Centres at which advice and training will be available to businessmen; an IT '82 stamp to be issued by the Post Office in September 1982 and additional support for computer-aided design, robotics, and fibre optics.

The Government has also recently announced that they will set up a network of IT Centres based on the successful Notting Dale Technology Centre, described in *Your Computer* last month. The Centre will aim to give unemployed young people training and work experience in microelectronics and computing skills.

IT '82 will end with a two-day conference and exhibition at the new Barbican Arts Centre in London on December 8 and 9 with international speakers and more than 1,000 delegates. ■

REVIEW

MORPHY V. CHAMPION

The Morphy and the Champion Sensory Challenger are a new breed of chess machine — their power and speed would be more than a match for the celebrated Sargon 2.5 from whom they are both descended. John White is the referee.

TWO MAJOR developments in the last year have changed the type of chess computer commercially available. The first is the widespread introduction of sensory boards which have eliminated the need to enter moves by pressing buttons. This greatly reduces operator errors, but means that players are no longer obliged to learn algebraic notation — something I had avoided for years but learned within four weeks of buying my first chess computer.

The second development is the incredible speed and strength of the best modern machines. New methods of targeting — using a superior evaluation function and keeping major pieces stored in a separate attack table — enable the machines to make the most efficient use of alpha-beta searching. This increases the speed of move-searching tremendously. Occasionally, however, the program makes an error, and takes as long as any of the older machines to make a move.

Strictly for experts

In the position shown in figure 1, the Morphy program playing at level 4 — average response time 2.25 minutes — took more than 23 minutes to find its move. The introduction of faster CPU chips has also accelerated play by a factor of about two. Double speed does not, however, imply double strength.

The strengths of the Morphy/Applied Concepts, March 1981 — and the Champion Sensory Challenger — Fidelty, October 1981 — are a great improvement on the earlier machines. As usual, wild claims have been made about their playing strengths. The manufacturers are more modest. Applied Concepts claims ratings of 1800-1900 — BCF 150-160 — while Fidelity's strength of 1771 is given extra credibility by its endorsement by the American Chess Federation. These ratings all apply to the top levels, but these involve excessive response periods.

The top normal playing levels — around two-three minutes per move — would achieve ratings of around BCF 130-140 against opponents not used to playing chess computers. With experience, any competent chess player can defeat a chess computer once he has determined its weaknesses. Ratings for chess computers are subject to considerable error. The machine gains by the fact that, unlike a human, it cannot make a simple blunder; on the other hand, it can never learn by its mistakes.

Targeting can also be carried to its extreme to solve chess problems of the "mate-in-three" type with fantastic speed. Champion Sensory Challenger has taken advantage of this with special mate-solving levels. Morphy does not have this facility and relies instead on its normal search to solve mating problems at a slower speed.

Both these machines have fast, lower-strength levels and can suggest moves to beginners. I could not possibly recommend either of these machines to the beginner — weaker machines are available at a fraction of the price. By the time a beginner could beat either of these monsters, not only would it be obsolete, but electricity probably would be as well.

Both machines can "think" while their opponent decides his move — they assess their response to the move they calculate their opponent will make. The machines can also prompt their opponent by revealing which move they think he should make. Again, both these machines offer random selection between moves of nearly equal merit — an important facility which makes all games different.

Morphy and Champion Sensory Challenger owe much of their design to the Spracklen husband-and-wife team. Both machines are, therefore, descendants of the famous Sargon 2.5 chess program and both are significantly stronger. The Spracklens now work for Fidelity.

It seems to have been the Spracklens who pioneered the new generation of super-fast chess computers with the Sargon 2.5. All programs they have written have been notoriously powerful. Kate Spracklen is a tournament player; Dan worked as a professional

The Champion Sensory Challenger, left, from Fidelity Electronics offers a top-quality end-game. The design of Morphy, above, and the Champion both owe a debt to the Spracklen husband-and-wife team whose pioneering work on the Sargon 2.5 program transformed computer chess.

computer programmer before devoting his time to the development of chess programs.

The Sargon 2.5 was manufactured by Applied Concepts and marketed by Chafitz. Chafitz has now withdrawn from the computer-chess market but Applied Concepts still manufactures and distributes chess machines. The Sargon 2.5 was a chess cartridge which plugged into a box containing most of the electronics. This limited the program to 8K of ROM. The box is now known as the Great Game Machine and Morphy is the new cartridge which plugs into it. The Great Game Machine lacks a touch-sensitive board — operation is by pressing buttons.

The improvements of Morphy on the Sargon 2.5 include faster play — its play at level 3 has an average response time of 15 seconds. That is reckoned to be equivalent to the 2.5's level 4 whose average response was two minutes. Morphy also has a better appreciation of positional play, better castling sense and an improved book-opening library. Space was made for this by deleting the unnecessary messages which the 2.5 used occasionally to flash, such as "You've been practising". Morphy also features an improved end-game which is entered only when the remaining level of material is sufficiently low.

Because Morphy is a module, it will be possible to replace it at a later date with improved modules. Meanwhile, owners of the 2.5 can buy the Morphy cartridge to update their Modular Game System, as the Great Game Machine used to be called. An important addition has been the introduction

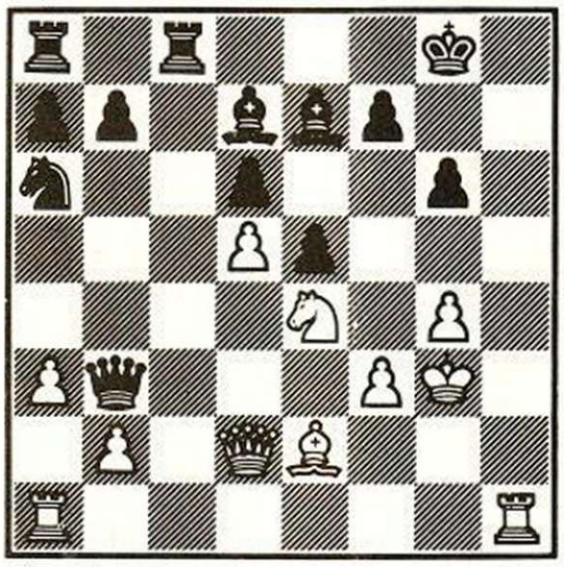


Figure 1.

of two further chess modules which allow continuous play for one game of chess.

Although the book-opening library of Morphy is better than the 2.5's, it is still not very good. The King's Gambit, for example, runs only two moves deep in one of the main lines. The Grunfield-opening cartridge was made available in June 1981, and covers the openings in great depth. When the book cartridge is exhausted, it gives a signal. You then remove it and replace it with Morphy for the mid-game play. It is possible to select your opening, and to obtain prompts for the next move in the opening.

The end-game seems to start when the material count is less than about 25, counting a queen as 9, a rook as 5, and so on in the usual way. When this point has been reached, Morphy also gives a signal. The player can continue when Morphy switches in extra end-game routines. Alternatively, Morphy can be taken out and the Capablanca cartridge inserted for a powerful finish. Capablanca has been available since October 1981.

Morphy has nine playing levels, of which three — levels 4, 7 and 8 — provide the normal top playing strength. That is, the average response time does not exceed three minutes per move. Other levels provide for postal chess, faster games or beginners.

The programmers claim to have taken special care to take mobility into account with Morphy. This gives the program a surprising degree of strategic insight into positions. I have frequently found that my pieces have somehow become tied up while Morphy retains full mobility, and I have found it very difficult to free my position. This is a considerable and very impressive achievement by the designers. In addition, Morphy will sometimes even make positional sacrifices; for example, exchanging a bishop for one or two pawns on the weak enemy KB2 square.

Strategic weakness

On the other hand, it is curiously obtuse about sacrifices made against its own pawn formation, and I have often won games by this method. Another surprising strategic weakness is the ease with which the opponent can inflict isolated double pawns on Morphy. These become a terrible handicap in the end-game — if not earlier.

The tactical play of Morphy must not be scorned either. Although not so fast as Champion Sensory Challenger at devising combinations, it can easily see six or seven ply ahead in mid-game. It will, for example, sacrifice a bishop for three pawns in a carefully-worked combination involving an intermediate check, as I have learnt to my cost.

Although the average response times for Morphy to make its move are as stated by the manufacturer, times can vary widely. In games that are either very complicated, or very quiet, the program frequently overruns its stated tournament times, and would lose in a real competition. The program does not automatically adjust its time for thinking according to the time it has remaining.

When the end-game routines are called, Morphy slows noticeably. It is apparent that it can now see up to 10 ply ahead in some lines. Promotion of a pawn now becomes of paramount importance, and Morphy will make any sacrifice to delay arrival of an enemy pawn on the eighth rank, unnecessarily giving up several pieces — the horizon effect — to delay the fateful move.

The end-game has always been the weakest part of any chess computer's game. The play by Morphy is very impressive, and it is, I think, the first commercially-available computer which could win a simple king and rook versus king ending. It plays a bishop,

(continued on next page)

(continued from previous page)
knight and king versus king ending well, driving the king into a corner, but fails to realise that the corner must be of the same colour as the bishop for checkmate.

The king is used aggressively and accurately in the end-game — I always felt that the Sargon 2.5 king adopted a kamikaze approach, hurling itself into the fray. Only the pawns' positioning leaves something to be desired.

A considerable amount of theory has been amassed on computer chess end-games, and the Capablanca end-game cartridge reputedly uses look-up tables to find its moves. With 12K of ROM and 3K of RAM, it is claimed to be the only commercial chess program dedicated to playing the end-game. It will also recognise draws, under the three-move or repetition and 50-move rules.

Variable vocabulary

Sad to say, however, it still cannot win the king, bishop and knight ending against a king, and the difference in the beep tone between it and Morphy is disconcerting. Nevertheless, Capablanca is a useful addition to Morphy, and can look up to 15 ply ahead.

The Great Game Machine and Morphy cost around £295, but can sometimes be found at discount prices. The cartridge alone costs about £95, and Grunfield and Capablanca also cost about £95 so that the complete chess program will cost around £485. Grunfield, which consists essentially of look-up tables, seems to be overpriced when compared with Morphy which is the culmination of years of research.

Other cartridges available for the Great Game Machine include Borchek draughts at about £70, as well as several others. Borchek is one of the strongest commercially-available draughts programs. The Morphy program can also be found in the Morphy Encore machine which lacks the capability to change cartridges, but is otherwise the same as the Great Game Machine. It is available at the very reasonable price of £180.

Fidelity's Champion Sensory Challenger or CSC consists essentially of the older Sensory Voice Challenger with a new program. Thus, it offers the sensory board of its predecessor, 64 pre-programmed games against grandmasters, 64 different book openings, a real-time clock and a voice in one of four languages.

I thoroughly dislike the voice, and switched it off during most of the testing. The voice can have its volume or its vocabulary altered, or it can be replaced by a beep tone. The 64 games against grandmasters are certainly interesting, but they must consume a good deal of expensive ROM. I feel that the voice and these games should be offered as optional extras, with a reduction in the price of the main unit.

The sensory board is a delight to use, and is the same as those of the Sensory 8 and Sensory Voice machines. Fidelity also has the most enviable reputation for reliabililty, and some dealers are offering extended, two-year guarantees. The whole unit is built like a wood and plastic battleship — excellent. A printer, costing around £170, can also be used to provide a permanent record of the game.

Inside the machine, the previous Z-80 chip and program have been superseded by a Spracklen-designed program on a 6502 chip. Later models will bear the faster 6502A microprocessor. The CSC has performed very well in microcomputer chess tournaments, winning the 1980 World Microcomputer Chess Championship and the 1980 North American Microcomputer Chess Championship outright. The 6502A Elite version won the 1981 World Microcomputer Championship in Hamburg, West Germany.

As you might expect, the standard of play is outstanding and very fast — even by the standards set by the other machines. The style of play bears surprisingly little resemblance to Morphy, despite their common origin, and a few features are noticeably different.

For example, the older Sargon 2.5 was criticised for its propensity to exchange its bishops for opponent knights early in the game. Morphy, however, can hardly be induced to make this exchange, with important implications for play in, say, the Nimzowitsch defence. CSC retains the pattern of exchange of the 2.5. It is debatable which approach is more correct.

Other features of CSC's play include the fact that it is not so prone to suffering from doubled pawns as Morphy. However, it does retain the 2.5's curious habit of making a move, changing its mind, and moving back again in quiescent positions. Equally, in quiescent positions, it will sometimes make a peculiar king move — sometimes back towards the centre immediately after castling.

Stunning speed

The CSC does not consider mobility factors to nearly the same extent as Morphy, and it is easy to inflict a "bad bishop" or "bad knight" on it. Nevertheless, its power in combinations coupled with the speed with which it performs them makes it easy to see why it has done so well in computer tournaments where ability to play accurately is more important than the ability to form a plan. On the other hand, Philidor has also done well in tournaments precisely because it can form simple plans.

CSC makes automatic moves at once — those situations where only one move is legal — unlike virtually all other chess computers which spend a long time calculating the opponent response. Obviously, when this happens, CSC is unable to prompt the opponent. Simple, strong moves, such as captures, are also made at stunning speed.

CSC can be programmed to complete all its moves within certain time limits. It adjusts the speed of its response according to the time remaining, and can never lose on time. This important facility means that at corresponding time levels it is at a disadvantage with respect to Morphy, which will always calculate its moves to completion. This is a criticism of Morphy rather than of CSC.

There are eight levels available for normal play, with further levels for problem solving — which is particularly easy to set up on the sensory board — mating problems and postal chess. The eighth level takes an average of six minutes to make its move, while the sixth level takes only three minutes. CSC takes little more than a minute to find the correct move for figure 1 — this does not, of course, imply that it chose it for the same reason, and it gives a different prompt compared with Morphy's.

Useful for openings

The opening library of CSC is well varied and relatively deep in many of the main lines, leading the machine well into the middle game. Unusually, the book is accessible whether the human plays from the top or bottom of the board or as black or white. Unusually, too, the opponent can ask for a prompt for his next book move while the machine is still playing from the book. This is useful to teach openings.

Fidelity does not give much prominence to the quality of CSC's end-game. This is surely a mistake, since the end-game play is absolutely first class — the best that I have seen in a commercial chess machine. It plays a rook and pawn versus rook ending brilliantly, looking up to 10 ply ahead at the higher levels. It can give mate with a king and rook versus a king, but, like Morphy, drives the enemy king into the wrong corner with a bishop and knight.

The end-game play of grandmasters is well known to be the greatest difference between them and the rest of us, and their play has been studied for many years by psychologists and others in an attempt to find why. These attempts have largely been fruitless — grandmasters themselves admit that they do not know how they assess positions.

The end-game play of all Spracklen-designed programs is very strong, and it seems that they have managed to pin down the ingredients which make good end-game play. A book entitled *How to play the end-game in chess* by these two would make fascinating reading.

The Champion Sensory Challenger costs about £330 — and may be found at discount prices — and the board can also be used as a board between two human players when no illegal move will be accepted. It is disappointing to note that the program is not supplied on an interchangeable cartridge — particularly sad since this facility is available on the down-market Mini Sensory Challenger.

CONCLUSIONS

- Morphy and Champion Sensory Challenger justify their reputations as two of the most powerful chess computers on the market.
- Morphy is supplied on a cartridge which can be extended by contiguous play or by replacement at a later date with a superior version.
- CSC is faster and superior at playing mid-game combinations — at equal response times — for those who like a real battle, and plays a superior end-game.
- Morphy plays a more human style of chess, which a positional player will appreciate better.
- CSC is less expensive than the full Morphy-Grunfeld-Capablanca combination and has a sensory board and also the voice–if you like it.
- I can strongly recommend both machines. ■

ELECTRONIC GAMES

COLOUR CARTRIDGE T.V. GAME

SEMI-PROGRAMMABLE T.V. GAME + 4 Cartridges + Mains Adaptor
Normal Price £73
NOW REDUCED TO: £39.50 inc VAT

DATABASE T.V. GAME

FULLY PROGRAMMABLE CARTRIDGE T.V. GAME
14 Cartridges available
Normal Price £87.86
NOW REDUCED TO: £59 inc VAT

ATARI T.V. GAME

The most popular T.V. Game on the market with a range of over 40 cartridges including SPACE INVADERS with over 112 games on one cartridge.
£95.45 inc VAT

SPACE INVADERS

Hand-held Invaders Games available **£19.95**
+ Invaders Cartridges available to fit
ATARI/RADOFIN/ACETRONIC/PHILIPS G7000
- Cartridges also available for
MATTEL/TELENG/ROWTRON/DATABASE/INTERTON

CHESS COMPUTERS

MANY UNITS ARE COVERED BY THE EXCLUSIVE SILICA SHOP 2 YEAR GUARANTEE

We carry a range of over 15 different Chess computers:

Electronic Chess	£29.95
Chess Traveller	£39.95
Chess Challenger 7	£79.00
Sensory 8	£119.00
Sensory Voice	£259.00

SPECIAL OFFERS:
VOICE CHESS CHALLENGER
Normal Price £245 **NOW £135.00**
SARGON 2.5/BORIS 2.5
Normal Price £273.70 **NOW £199.95**
All prices include V.A.T.

TELETEXT ADD-ON ADAPTOR £199 inc VAT

THE RADOFIN TELETEXT ADD-ON ADAPTOR

Plug the adaptor into the aerial socket of your colour T.V. and receive the CEEFAX and ORACLE television information services.

THIS NEW MODEL INCORPORATES:
- Double height character facility
- True PAL Colour
- Meets latest BBC & IBA broadcast specifications
- Push button channel change
- Unnecessary to remove the unit to watch normal TV programmes
- Gold-plated circuit board for reliability
- New SUPERIMPOSE News Flash facility

SPEAK & SPELL

Normal Price £49.95
NOW REDUCED TO:
£39.50 inc VAT

Teach your child to spell properly with this unique learning aid. Fully automatic features and scoring. Additional word modules available to extend the range of words.

ADDING MACHINE OLYMPIA HHP 1010

Normal Price £57.21
NOW REDUCED TO:
£34 inc VAT

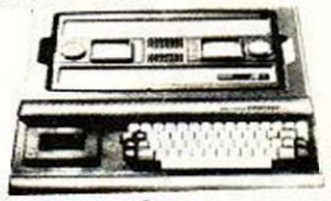
Uses ordinary paper! No need to buy expensive thermal paper!
Fast add listing PRINTER CALCULATOR 2 lines per second. 10 digit capacity. Uses normal adding machine rolls. Battery or mains operated.
Size 9¼"x4¾"x2¾"
(Mains adaptor extra)

24 TUNE ELECTRONIC DOOR BELL

Normal Price £19.70
NOW REDUCED TO:
£12.70 inc VAT

Plays 24 different tunes with separate speed control and volume control. Select the most appropriate tune for your visitor, with appropriate tunes for different times of the year!

MATTEL T.V. GAME



The most advanced T.V. game in the world. 20 cartridges available. Add on KEYBOARD coming soon to convert the MATTEL to a home computer with 16K RAM, fully expandable and programmable in Microsoft Basic. Other accessories will be available later in the year.
£199.95 inc VAT

HAND HELD GAMES

EARTH INVADERS

These invaders are a breed of creature hitherto unknown to man. They cannot be killed by traditional methods — they must be buried. The battle is conducted in a maze where squads of aliens chase home troops. The only way of eliminating them is by digging holes and burying them.
£23.95 inc VAT

HAND HELD GAMES

GALAXY 1000

The 2nd generation Galaxy Invader. The invaders have re-grouped and have a seemingly endless supply of spacecraft whilst the player's arsenal is limited to just 250 missiles to be launched from 3 missile stations. You have to prevent the invaders landing or from destroying your home defences.
£19.95 inc VAT

THE OLYMPIA — POST OFFICE APPROVED TELEPHONE ANSWERING MACHINE

WITH REMOTE CALL-IN BLEEPER

This telephone answering machine is manufactured by Olympia Business Machines, one of the largest Office Equipment manufacturers in the U.K. It is fully POST OFFICE APPROVED and will answer and record messages for 24 hours a day. With your remote call-in bleeper you can receive these messages by telephone wherever you are in the world. The remote call-in bleeper activates the Answer/Record Unit, which will at your command repeat messages, keep or erase them, and is activated from anywhere in the world, or on your return to your home or office. The machine can also be used for message referral, if you have an urgent appointment, but are expecting an important call, simply record the 'phone number' and location where you can be reached. With optional extra bleepers (£13 each) this facility can be extended to colleagues and members of the family. Using a C90 standard cassette you can record as many as 45 messages. The announcement can be up to 16 seconds long and the incoming message up to 30 seconds long.
The machine is easy to install and comes with full instructions. It is easily wired to your junction box with the spade connectors provided or alternatively a jack plug can be provided to plug into a jack socket. Most important, of course, is the fact that it is fully POST OFFICE APPROVED.
The price of £135 (inc VAT) includes the machine, an extra-light remote call-in Bleeper, the microphone message tape, A.C. mains adaptor. The unit is 9¾"x6"x2½" and is fully guaranteed for 12 months. The telephone can be placed directly on the unit — no additional desk space is required.

£135 inc VAT

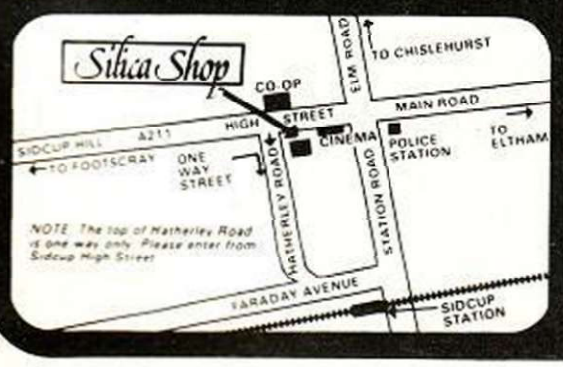
PRESTEL VIEWDATA

The ACE TELCOM VDX1000 Prestel Viewdata adaptor simply plugs into the aerial socket of your television and enables you to receive the Prestel/Viewdata service in colour or black & white.

Features —
- Simplified controls for quick, easy operation
- Special graphics feature for high resolution
- State-of-the-art microprocessor controller
- Standard remote telephone keypad with Prestel keys * #
- Auto dialler incorporated for easy Prestel acquisition
- True PAL colour encoder using reliable IC — chroma filter and dela line incorporated for minimum picture interference maximum fidelity
- Includes convenient TV — Prestel switchbox
- Easily connected to standard home or office telephone lines
- Fully Post Office approved

SPECIAL PRICE **£228.85** inc VAT

FOR FREE BROCHURES — TEL: 01-301 1111



For free illustrated brochure and reviews on our range of electronic games please telephone 01-301 1111. Free delivery service available. To order by telephone please quote your name, address and ACCESS/BARCLAYCARD number, and leave the rest to us. Post and packing Free of Charge. Express 48hr delivery service available.
- CALLERS WELCOME — Demonstrations daily at our Sidcup shop open from 9am 6pm Monday Saturday (Early Closing Thursday 1pm — Late Opening Friday 8pm)
- 2 YEAR GUARANTEE — All goods are covered by a full year's guarantee and many are further covered by our exclusive Silica Shop 2 year Guarantee
- MONEY BACK UNDERTAKING — If you are unsatisfied with your purchase and return it within 7 days we will give you a full refund
- AFTER SALES SERVICE — Available on all machines out of guarantee
- COMPETITIVE PRICES — We are never knowingly undersold
- HELPFUL ADVICE — Available on the suitability of each machine
- CREDIT FACILITIES — Full credit facilities available over 12, 24 or 26 months at competitive rates of interest
- PART EXCHANGE SCHEME — available on second hand machines
- CREDIT CARDS WELCOME — Access, Barclaycard, Diners Club, American Express

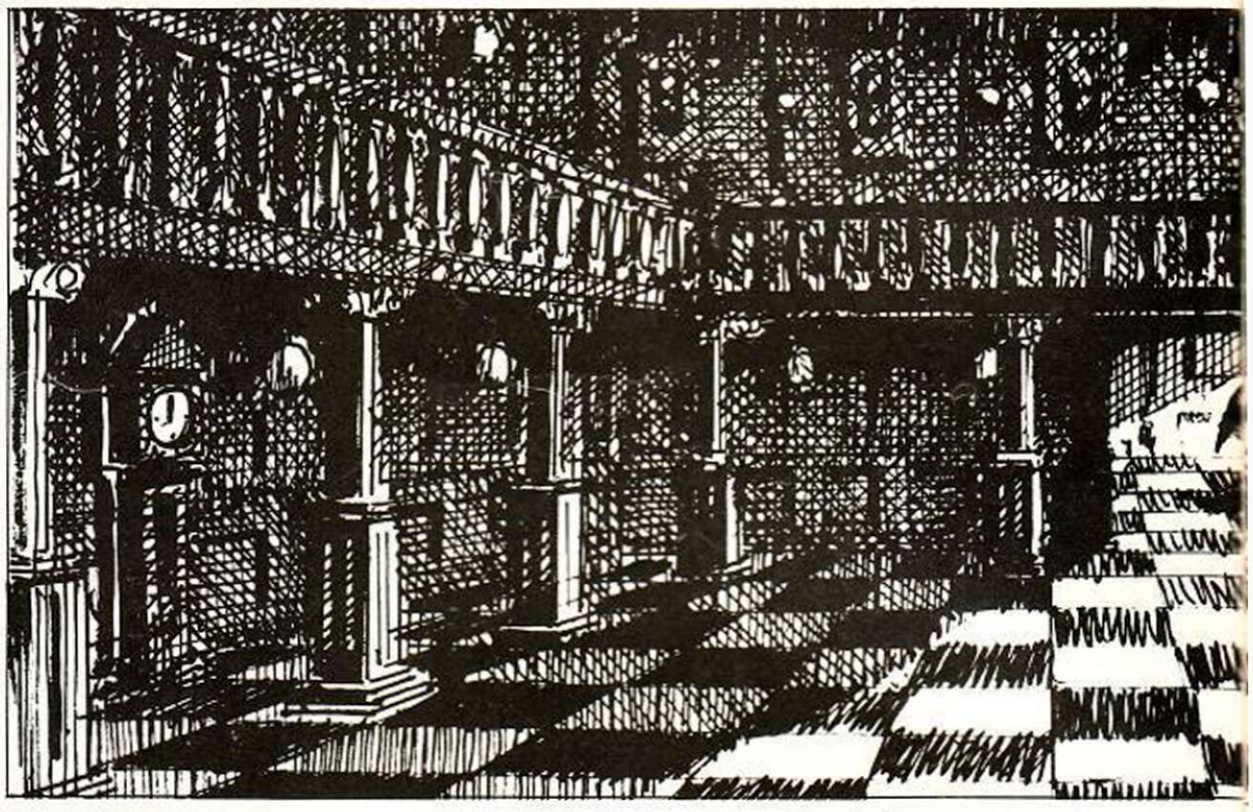
SILICA SHOP LIMITED DEPT YC I-82
1-4 The Mews, Hatherley Road, Sidcup, Kent DA14 4DX
Telephone: 01-301 1111 or 01-309 1111

SILICA SHOP

GAMES

MYSTERY AT THE HOUSE

No-one has ever left the House of Treasure alive to tell of the fortune it conceals. Now Chris Davison's adventure beckons to you.



THE TROUBLE WITH most mini Adventure games in Basic is that they tend to suffer from one or more of the following:

- You find monsters, kill them and collect treasure indefinitely.
- You can move only forwards and to the sides — one cannot retrace one's steps.
- The adventure lacks any aim, and if it does have one, it is the same each time.
- They are very difficult to amend without a great deal of fuss and wasted time.

In my mini Adventure, I hope to overcome most of these problems. Without divulging too many secrets, let me first explain the objects of the game.

You are at the entrance of a very old house which is rumoured to contain a huge hoard of treasure. However, no-one has ever left it alive to tell the tale. This adventure is not as simple as it looks and took me almost a month to solve. I have succeeded only once since then. Your score is kept throughout and is calculated on treasure, monsters, strength, time, keys, lamps and so on.

I will try to explain how to delete, expand or otherwise alter the program to suit your needs.

The progam is written in XTAL 2.2 Basic for the Sharp MZ-80K, and when run occupies about 14K — 13.2K to be exact. It should work with only minimal alterations on any micro running a Microsoft-type Basic. Graphics can be added very easily using a subroutine which is called from the description routine.

Routines

0000 — 0060 Dims, call various set-up routines
0070 — 0200 Actual program — calls all other routines
1000 — 1250 Set up house details
1300 — 1396 Set up treasure, monsters and other variables
1400 — 1470 Options
1500 — 1530 Output of descriptions
1600 — 1650 Your choice — e.g., north south
1700 — 1810 Move, calculate position of walls, etc.
1900 — 1930 Explore
2000 — 2050 Open
2100 — 2160 Stairs
2200 — 2260 Trap
2300 — 2380 Key
2400 — 2460 Lamp
2500 — 2540 Trigger
2600 — 2650 Cellar entrance
2700 — 2780 Door
2900 — 2970 Desk
3000 — 3040 Cupboard
3100 — 3150 Clock
3200 — 3240 Piano
3300 — 3350 Dead
3400 — 3450 Clue
3500 — 3586 Comblock etc.
4000 — 4195 Monsters
4200 — 4330 Status
5000 — 5060 Kidnapped
5100 — 5270 Treasure
6000 — 6060 Strength
7000 — 7270 Treasure or trap
8000 — 8200 Instructions

As you can see from the list of routines, it is very much a modular program, and as such is very simple to alter to suit your needs. If you wished to change the piano for a wardrobe, you place your new routine at 3200-3240.

If you wish to plot the graphics for a wardrobe, you could do it within the routine or call a new routine to do so. This new routine could then be used as the base for all your other graphics routines.

Those with computers of limited storage could use this idea to fit the program into their available memory. The routines are reasonably self-explanatory; nevertheless, I have provided a list of variables and the details of the two main arrays.

Variables

M(, ,) — House details
T(, ,) — Treasure details
D$( ) — Descriptions
MM$( ) — Monsters
A( ),B( ) — Location of clues
TI$ — Time
CL$ — Clue in string form
CH$ — Your clue guess
A$ — General
A,B,C,D,E,F — Numeric general workhorses
XX , YY — Cellar exit
X , Y — Your location
Z — Your level — floor
ST — Strength
L — Lamp
K — Key
MK — Monsters killed
SC — Score
CC — Clues collected
MO — Monster flag
TF — Treasure flag

Both M( ) and T( ) have numeric terms which represent some description. These are used to access the routines as well as to calculate the walls, etc.

What the codes mean:

	M( )	T( )
0	External wall	N/A
1	Hall	Trap
2	Locked door	Key
3	Open door	Lamp
4	Staircase	Trigger
5	Desk	Cellar entrance
6	Cupboard	Clue
7	Clock	Comblock
8	Piano	Treasure
9	Chair	N/A
10	Statue	N/A
11	Fireplace	N/A
12	Bookcase	N/A

OF TREASURE

Each of the three main floors — expanded to as many as you like by re-dimensioning and incrementing the For-Next loops in the set-up routines — has a standard hall layout:

	X	H	X		
X		H		X	X
H	H	H	H	H	H
X		H		X	X
	X	H	X		
	X	H	X		

The data string gives the computer a random choice of places to put the doors which are marked with crosses in the diagram. These positions vary on each floor.

You may have noticed that there are no walls in M(,,). They are calculated by the fact that if you are in a hall, you cannot see anything where M(,,) exceeds three — clock, cupboard, etc. The same idea holds true when you are in a room — that is, you cannot see the hall. The treasure is distributed randomly. However, its position may depend on what is in the corresponding M(,,) array.

If you wish to add a new routine, there are one or two points you may wish to know: the routines are called by the On-Gosub at line 2010; should you wish to add a new treasure routine, there is a similar On-Gosub for treasure at line 1920.

```
0 REM ********************************
1 REM **                            **
2 REM **      TREASURE HOUSE        **
3 REM **           by               **
4 REM **        C.J.DAVISON         **
5 REM **                            **
6 REM **    in XTAL 2.2 BASIC       **
7 REM ********************************
8 CLS
9 GOSUB 8000
10 REM          HOUSE MK I
20 DIM M(7,7,3),T(7,7,3),D$(12),MM$(30),A(4),B(4)
30 RESTORE
40 GOSUB 1000
50 GOSUB 1300
55 PRINT "HIT ANY KEY TO PLAY":J=INCH
56 TI$="000000"
60 CLS
70 GOSUB 1400
80 GOSUB 1600
90 IF INT(1+6*RND(8))=4 THEN GOSUB 4000
100 IF ST<1 THEN GOSUB  6000
110 IF Z=0 AND X=XX AND Y=YY THEN GOSUB 5000
200 GOTO 70
1000 REM          SET UP HOUSE DETAILS
1010 FOR B=1 TO 3:FOR A=1 TO 6
1020 M(A,3,B)=1:M(3,A,B)=1
1030 NEXT A,B
1040 A=INT(1+6*RND(7))
1050 FOR B=1 TO 3:M(A,3,B)=4:NEXT B
1060 DATA 2,2,1,1,2,3,4,1,5,2,6,2,3,1,4,2,5,2,6,1,4,5,4,6,5,4,6,4,9
1070 FOR F=1 TO 3:RESTORE
1080 READ A:IF A=9 THEN 1120
1090 B=INT(1+A*RND(9))
1100 FOR C=1 TO B:READ D,E:NEXT C:M(D,E,F)=INT(2+2*RND(5))
1110 IF B=A THEN 1080 ELSE READ D,E:B=B+1:GOTO 1110
1120 NEXT F
1130 FOR C=0 TO 3:FOR A=1 TO 6:FOR B=1 TO 6
1140 IF M(B,A,C)<>0 THEN 1180
1150 M(B,A,C)=INT(5+8*RND(3))
1180 NEXT B,A,C
1190 FOR D=1 TO 2
1200 A=INT(1+6*RND(7))
1210 B=INT(1+6*RND(7))
1220 C=INT(1+3*RND(5))
1230 IF M(A,B,C)<5 OR M(A,B,C)>8 THEN 1200
1240 IF D=1 THEN T(A,B,1)=5
1242 IF D=2 THEN T(A,B,C)=7
1245 NEXT D
1250 RETURN
1300 REM              OTHER BITS
1310 K=0:X=3:Y=6:Z=1:L=0:TF=0
1320 DATA HALL,DOOR,DOOR,STAIRCASE,DESK,CUPBOARD
1330 DATA CLOCK,PIANO,CHAIR,STATUE,FIREPLACE,BOOKCASE
1340 FOR A=1 TO 12:READ D$(A):NEXT A
1350 MO=0:ST=100:CL$=STR$(INT(1000+8999*RND(7))):CC=1
1360 FOR A=1 TO 6:FOR B=1 TO 6
1370 M(A,B,0)=INT(5+8*RND(8))
1380 NEXT B,A
1381 DATA TROLL,GHOST,IMP,BAT,GIANT,ZOMBIE,GROCKLE,HOUND,DEVIL,KOBOLD,RAT,XORN
1382 DATA GOBLIN,ORCUS,HYDRA,SERPENT,BASILISK,PHEONIX,MEDUSA,SALAMANDER
1383 DATA GARGOYLE,BEHOLDER,JUBILEX,GOLEM,VAMPIRE,HELL HOUND,GUARDIAN,ORC,ELF
1384 FOR T=1 TO 29:READMM$(T):NEXT
1385 XX=INT(1+6*RND(8)):YY=INT(1+7*RND(7))
1386 FOR A=1 TO 6:FOR B=1 TO 6:FOR C=0 TO 3:IF T(A,B,C)<>0 THEN 1388
1387 IF INT(1+7*RND(7))=5 THEN T(A,B,C)=8
1388 IF INT(1+4*RND(7))=2 AND T(A,B,C)=0 THEN T(A,B,C)=INT(1+4*RND(8))
1389 NEXT C,B,A
1390 FOR A=1 TO 4
1391 B=INT(1+6*RND(8)):C=INT(1+6*RND(9)):D=INT(1+3*RND(6))
1392 IF T(B,C,D)<>0 OR M(B,C,D)<5 OR M(B,C,D)>8 THEN 1391
1393 T(B,C,D)=6
1394 NEXT A
1396 RETURN
1400 REM              OPTIONS
1401 PRINT
1410 M=M(X,Y-1,Z):A$="North "
1420 GOSUB 1500
1430 M=M(X-1,Y,Z):A$="West"
1440 GOSUB 1500
1450 M=M(X+1,Y,Z):A$="East"
1460 GOSUB 1500
1462 M=M(X,Y,Z):A$="By the side "
1464 GOSUB 1500
```

(continued on next page)

(continued from previous page)

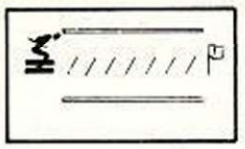
```
1466 M=M(X,Y+1,Z):A$="South "
1468 GOSUB 1500
1470 RETURN
1500 REM              DESCRIPTIONS
1510 IF ((M(X,Y,Z)=1 OR M(X,Y,Z)=4)AND M)4) OR M=0 THEN RETURN
1515 IF (M(X,Y,Z)>4 OR M(X,Y,Z)=3) AND (M(5 AND M(>3) THEN RETURN
1516 IF M(X,Y,Z)=2 AND M)4 THEN RETURN
1520 PRINT A$:" of you is a ".D$(M)
1530 RETURN
1600 REM              YOUR CHOICE
1610 PRINT "■(1)move  (2)explore  (3)open  (4)status"
1625 PRINT
1630 A=INCH-48:IF A(1 OR A)3 THEN GOSUB4200:GOTO 1600
1640 ON A GOSUB 1700,1900,2000
1650 RETURN
1700 REM              MOVE
1710 PRINT "(1)north  (2)south   (3)west   (4)east"
1730 A=INCH-48:IF A(1 OR A)4 THEN 1730
1740 IF A=1 THEN C=-1:B=0
1750 IF A=2 THEN C=+1:B=0
1760 IF A=3 THEN C=0:B=-1
1770 IF A=4 THEN C=0:B=+1
1780 M=M(X+B,Y+C,Z)
1781 IF M=0 THEN RETURN
1785 IF M(X,Y,Z)=3 THEN GOSUB 2700:GOTO 1800
1786 IF M(X,Y,Z)=2THEN GOSUB 2700:IF M)4 THEN RETURN
1790 IF ((M(X,Y,Z)=1 OR M(X,Y,Z)=4)AND M)4) OR M=0 THEN RETURN
1791 IF (M(X,Y,Z)>4 OR M(X,Y,Z)=3) AND (M(5 AND M(>3) THEN RETURN
1792 IF M(X,Y,Z)=2 AND M)4 THEN RETURN
1800 X=X+B:Y=Y+C
1810 RETURN
1900 REM              EXPLORE
1910 IF M(X,Y,Z)=4 THEN GOSUB 2100:GOTO 1930
1920 ON T(X,Y,Z) GOSUB 2200,2300,2400,2500,2600,1250,1250,5100
1930 RETURN
2000 REM              OPEN
2010 ON M(X,Y,Z) GOSUB 1930,2700,2700,1930,2900,3000,3100,3200
2020 IF M(X,Y,Z)>1 AND M(X,Y,Z)(9 AND M(X,Y,Z)<>4 THEN 2050
2030 PRINT "I've never opened a ";D$(M(X,Y,Z))
2040 PRINT "and i don't intend to start now!"
2050 RETURN
2100 REM              STAIRS
2110 PRINT "Climb up or down?"
2120 PRINT "     1 or   2"
2130 A=INCH-48:IF A(1 OR A)2 THEN 2130
2140 IF (A=1 AND Z=3)OR(A=2 AND Z=1) THEN PRINT "you can't!":GOTO 2130
2150 IF A=1 THEN Z=Z+1:ELSE Z=Z-1
2160 RETURN
2200 REM              TRAP
2210 PRINT "CONGATULATIONS,you've just found a trap"
2220 A=INT(20+30*RND(7)):PRINT A;"of you strength units are used up"
2230 ST=ST-A
2240 PRINT "You are lucky,you are still alive,but    only just!"
2250 PRINT "Tread more carefully in future...."
2260 RETURN
2300 REM              KEY
2310 PRINT "You have just found a key,however it may  well be boobytrapped!"
2320 PRINT "■Do you want it?":A=INCH
2330 IF A<>89 THEN PRINT "NO..ok suit yourself":RETURN
2340 IF INT(1+9*RND(7))<>3 THEN PRINT"The key's yours":K=1:T(X,Y,Z)=0:RETURN
2350 PRINT "      ****BOOM****"
2360 PRINT "■      BOOBYTRAPPED!"
2370 GOSUB 2220
2380 RETURN
2400 REM              LAMP
2410 PRINT "Ah ha,one lamp yours for the takeing"
2420 PRINT "Do you want it?":A=INCH
2430 IF A<>89 THEN PRINT "NO!":RETURN
2440 IF INT(1+9*RND(8))<>7 THEN L=1:PRINT"The lamp is yours":T(X,Y,Z)=0:RETURN
2450 PRINT "Oh dear this lamp wasn't for sale! you've got trouble...."
2460 GOSUB 2500:RETURN
2500 REM              TRIGGER
2505 IF M0=1 THEN RETURN
2510 PRINT "WELL DONE.....IDIOT"
2520 PRINT "you've just disturbed all the 'orrible  little buss!!!!"
2530 PRINT "Belive me your in for fun now!":M0=1
2540 RETURN
2600 REM              CELLAR ENTRANCE
2605 IF Z<>1 THEN RETURN
2610 PRINT "Well well well look what you've found"
2611 PRINT "Yes the cellar entrance!"
2615 PRINT "DO YOU WANT TO GO IN?":A=INCH
2620 IF A<>89 THEN PRINT "OK":RETURN
2630 IF L=0 THEN PRINT "Tough,you'll need a lamp!":RETURN
2640 Z=0:PRINT "Good luck":GOSUB 2530
2650 RETURN
2700 REM              DOOR
2710 IF M(X,Y,Z)=3 THEN PRINT "ok the door is open":RETURN
2720 PRINT "the door is locked"
2730 IF K<>1 THEN PRINT "you will need a key to open it":RETURN
2740 PRINT "do you wish to unlock it?":A=INCH
2750 IF A<>89 THEN PRINT "suit yourself!":RETURN
2760 M(X,Y,Z)=3:PRINT "the door is open"
2770 IF INT(1+9*RND(7))=3 THEN PRINT "the key is jamed in the lock":K=0
2780 RETURN
2900 REM              DESK
2910 IF INT(1+5*RND(8))<>2 THEN 2950
2920 PRINT "The desk is jamed,do you wish to force  it?":A=INCH
2930 IF A<>89 THEN RETURN
2940 ST=ST-INT(1+10*RND(8)):PRINT "UGGGGH, opened it!"
2950 IF T(X,Y,Z)=0 THEN PRINT "waste of time,it's empty":RETURN
2960 ON T(X,Y,Z) GOSUB 1250,2300,2400,2500,2600, 3400,3500
2970 RETURN
3000 REM              CUPBOARD
3010 IF L=0 THEN PRINT "It's too dark to see,you need a lamp":RETURN
3020 IF INT(1+9*RND(2))=4 THEN PRINT "Your lamps blown out!":L=0:RETURN
3030 GOSUB 2950
3040 RETURN
3100 REM              CLOCK
3110 PRINT "Creeeeeeek,the door is stiff and this   weakens you"
3120 ST=ST-INT(1+5*RND(9))
3130 IF INT(1+9*RND(8))=4 THEN GOSUB 4000
3140 GOSUB 2950
3150 RETURN
3200 REM              PIANO
3210 PRINT "Congratulations,you have found a KEY"
3220 IF T(X,Y,Z)<>2 THEN PRINT "But then again most pianos have keys!!!"
3230 GOSUB 2950
3240 RETURN
3300 REM              END
3305 PRINT
3310 PRINT "HA HA...THE HOUSE HAS CLAIMED ANOTHER    BODY!!!"
3320 PRINT "THE TREASURE LIES HIDDEN,YOU HAVE FAILED"
3330 PRINT "YOUR FINAL STATUS IS....................."
3340 GOSUB 4220
3350 GOTO 4309
3400 REM              CLUE
3410 PRINT "YOU HAVE FOUND A CLUE..."
3420 CC=CC+1:IF CC=5 THEN PRINT "THE LAST ONE YOU'LL NEED!"
3430 PRINT "THE NUMBER IS....";MID$(CL$,CC,1);" REMEMBER IT "
3440 T(X,Y,Z)=0
3450 RETURN
3500 REM              COMBLOCK
3510 PRINT "YOU HAVE FOUND THE PLACE TO DEPOSIT YOUR  CLUES"
3520 PRINT "ARE YOU READY TO TRY ?":A=INCH
3530 IF A<>89 THEN RETURN
3540 PRINT "■  ENTER THE CODE,AND AFTER CHECKING     PRESS (CR)"
3550 INPUT "*****";CH$:CH$=" "+CH$
3560 IF CH$<>CL$ THEN PRINT "WRONG....YOU HAVE FAILED..NOW DIE":GOTO 3300
3570 PRINT "■■■BRILLIANT YOU HAVE DONE WELL MY FRIEND"
3580 TF=1
3581 GOSUB 7000
3585 GOSUB 4200
3586 GOTO 4309
4000 REM                    MONSTERS
4010 IF M0=0 THEN RETURN
4020 A=INT(1+29*RND(8)):B=A+INT(1+4*RND(8))
4030 PRINT "■ you have just been confronted by a "
4040 PRINT MM$(A):PRINT "■What do you wish to do?"
4050 PRINT "(1) Retreat  (2) Attack  (3) Gamble"
4060 C=INCH-48:IF C<1 OR C>3 THEN 4050
4070 ON C GOTO 4080,4120,4160
4080 IF INT(1+3*RND(8))<>2 THEN PRINT "Escaped":RETURN
4090 PRINT "a ";MM$(A);" does not like chickens"
4100 PRINT "he attacks,good luck"
4120 PRINT "The ";MM$(A);" has ";B;"hit points"
4125 PRINT "■What's your punch factor?":U=INCH-48:IF U<1 OR U>9 THEN 4125
4126 PRINT
4130 ST=ST-U
4135 U=U+INT(1+5*RND(7)):B=B-U
4140 PRINT "Your punch leaves the ";MM$(A);" only";B
4145 PRINT "strength units!"
4150 C=INT(1+10*RND(8))
4152 B=B-C:IF B<1 THEN ST=ST-B:PRINT"you win..":MK=MK+1:RETURN
4154 ST=ST-C+2:PRINT "his hit leaves you with";ST;"points"
4156 IF ST<1 THEN RETURN:ELSE 4125
4160 A=INT(1+20*RND(6)):PRINT A;"Hit points are at stake"
4170 PRINT "Choose a number between 1 and ";20-A:INPUT B
4180 IF B=INT(1+(20-A)*RND(8)) THEN ST=ST+A:PRINT "YOU WIN....":RETURN
4190 PRINT "HA HA YOU LOSE":ST=ST-A
4195 RETURN
4200 REM                    STATUS
4210 PRINT "■■YOUR CURRENT STATUS IS....."
4215 PRINT"■■"
4220 PRINT "STRENGTH....";ST
4230 PRINT "MONSTERS KILLED....";MK
4235 PRINT  "TREASURE....";TR
4240 PRINT "KEY....";K
4250 PRINT "LAMP....";L
4260 PRINT "CLUES....";CC-1
4270 PRINT "LEVEL....";Z
4280 PRINT "COORDINATES....";X;Y
4290 PRINT"TIME.... ";LEFT$(TI$,2);":";MID$(TI$,3,2);":";RIGHT$(TI$,2)
4300 SC=MK*100+TR*10+(K+L)+10+ST-VAL(LEFT$(TI$,4))
4301 IF CC=5 THEN SC=SC*2
4302 IF TF=1 THEN SC=SC*2
4303 PRINT "■■YOUR SCORE IS **";SC;"**
4305 RETURN
4309 PRINT "■■DO YOU WANT ANOTHER GO?";
4310 A=INCH:IF A=89 THEN RUN
4320 CLS
4330 END
5000 REM              KIDNAPPED
5010 PRINT "uoooooooooosh you've just found a travel agent!"
5020 PRINT "And you have been kidnapped and released  somewhere,but where?"
5030 X=INT(1+6*RND(8))
5040 Y=INT(1+6*RND(8))
5050 Z=INT(1+3*RND(7))
5060 RETURN
5100 REM                TREASURE
5110 A=INT(1+900*RND(9))
5120 PRINT "You have found";A;"pieces of gold"
5130 PRINT "Do you want them?":B=INCH
5140 IF B<>89 THEN RETURN
5150 TR=TR+A:ST=ST-INT(A/40)
5155 T(X,Y,Z)=0
5160 IF INT(1+9*RND(8))<>2 THEN RETURN
5165 PRINT "■You have also found!"
5170 A=INT(1+9*RND(8))
5180 IF A=1 THEN PRINT "a sword":ST=ST+INT(1+20*RND(7))
5190 IF A=2 THEN PRINT "bad luck!":M0=1
5200 IF A=3 THEN PRINT "a potion":ST=ST+INT(1+20*RND(8))-5
5210 IF A=4 THEN PRINT "an axe":ST=ST+7
5220 IF A=5 THEN PRINT "a lamp":L=1
5230 IF A=6 THEN PRINT "a key":K=1
5240 IF A=7 THEN PRINT "a time warp":TI$="000000"
5250 IF A=8 THEN PRINT "a nugget":TR=TR+INT(1+800*RND(8))
5260 IF A=9 THEN PRINT "a good luck charm":M0=0:ST=ST+10
5270 GOTO 5160
6000 REM              STRENGTH
6001 IF TR<30 THEN GOTO 3300
6002 PRINT "■■■■■"
6010 PRINT "HMMM you seem to be out of energy"
6015 PRINT "a grand score of";ST;"you need help!"
6016 PRINT "Since you have";TR;"items of treasure"
6017 PRINT "I feel i do a deal with you"
6020 A=INT(9+20*RND(8)):A=INT(TR/A)
6030 PRINT "I'll sell you one unit of energy for    every";A
6040 PRINT "pieces of treasure you give me...OK":B=INCH
6050 IF B=89 THEN ST=ST+INT(TR/A):TR=TR-A*INT(TR/A):RETURN
6060 IF INT(1+4*RND(8))=3 THEN PRINT "*FOOL*":GOTO 3300:ELSE 6020
7000 REM                BOOBYTRAP
7010 PRINT "■■■The previous owner of the treasure made"
7020 PRINT "sure that his secret would remain hidden"
7030 PRINT "■for a long time,he also gave the finder"
7040 PRINT "one final test,if you win..the treasure"
7050 PRINT "is yours....if you lose DEATH"
7060 PRINT "do you want to take the chance":A=INCH
7070 IF A<>89 THEN PRINT "OK..YOU HAVE DONE WELL":RETURN
7080 PRINT "■■■GOOD LUCK"
7090 PRINT "■■The chest has a lock on it"
7100 PRINT "To open it you must crack the code HIT  (CR) TO CONTINUE":A=INCH
7110 FOR X=1 TO 4:A(X)=INT(1+9*RND(8)):NEXT X
7120 FORX=1TO4:FORY=1 TO 4:IF X=Y THEN 7130
7125 IF A(X)=A(Y) THEN V=1
7130 NEXT Y,X:IF V=1 THEN V=0:GOTO 7110
7140 PRINT "3 point will be give if you choose right number in right place"
7150 PRINT "1  point for right number urong place"
7155 S=0
7160 PRINT "■■ok type in your guess"
7170 FOR X=1 TO 4:B(X)=INCH-48:NEXT X
7180 FOR X=1 TO 4:IF B(X)=A(X)THEN S=S+3
7182 NEXT X
7190 FOR X=1 TO 4:FOR Y=1 TO 4
7200 IF X=Y THEN 7220
7210 IF B(Y)=A(X) THEN S=S+1:CALL 62
7220 NEXT Y,X
7230 FOR X=1 TO 4:PRINT B(X);:NEXT
7240 PRINT "**";S;"**"
7250 IF S=12 THEN PRINT "**ALL DONE**":TR=TR+INT(9999+99999*RND(8)):RETURN
7260 IF INT(1+10*RND(8))>=4 THEN PRINT "TIMES UP":GOTO 3300
7270 S=0:GOTO 7170
8000 REM                INSTRUCTIONS
8001 PRINT "■■              TREASURE HOUSE"
8002 PRINT "                ~~~~~~~~~~~~~"
8003 PRINT "■■"
8010 PRINT "You are in a large old house"
8020 PRINT "When the old man who lived there died"
8030 PRINT "he hid all his worldly goods in the "
8040 PRINT "house.He also hid a hoard of treasure     (valued at £2M!)"
8050 PRINT "      To find this treasure you must find various clues and,more"
8060 PRINT "important,the place to put them..."
8070 PRINT " BE WARNED,he also left traps for the     unwary,so go carefully"
8080 PRINT "also,things may not always be as they"
8090 PRINT "seem.■■■GO CAREFULLY MY FRIEND,AND GOOD LUCK"
8100 RETURN
8200 REM ***********THE-END***********
```

ZX80

JRS SOFTWARE

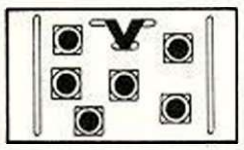
19 WAYSIDE AVENUE, WORTHING, SUSSEX, BN13 3JU
TELEPHONE WORTHING 65691 (Evenings and Weekends only)

ZX81



NOW ENHANCED!

ZX81 — SLALOM (16K RAM PACK REQD.)
Slalom events always draw great crowds to the ski resorts and the T.V. cameras are never far behind. **Now** the skier on your T.V. screen is directly under your control and his success in negotiating the slalom posts and achieving a fast time relies entirely on your skill with the ZX81 keys.



NOW ENHANCED

ZX81 — BLACK HOLES (16K RAM PACK REQD.)
Your starship is in an unknown galaxy consisting entirely of black holes which continually threaten to swallow you. Your skill at the controls and your ability to look and think many moves ahead is the only thing that stands between you and destruction. How long can you survive?

BOTH programs on one cassette £4.95

NEW — An ESSENTIAL addition to your 1K RAM ZX81 (or ZX80 8K ROM)
TOOLKIT (written by PAUL HOLMES)
Provides the following additional facilities:

Line renumber — you state starting number and increment value.
Search and replace — changes every occurence of a character as you require.
Free space — tells you how many free bytes you have left.

SPECIAL GRAPHICS ROUTINES

Hyper graphics mode — graphics never seen on a ZX81 before.
Open — instantly sets up as many empty print lines as you require.
Fill — used in conjunction with OPEN fills your screen instantly with your specified character.
Reverse — changes each character on your screen to its inverse video.

TAPE ROUTINE — provides a system **WAIT** condition until a signal is received in the cassette ear jack — many uses!

All these routines are written in machine code and together take up only 164 BYTES of your precious RAM — an incredible achievement!!

The price is incredible too! ONLY **£3.95** for cassette, including FULL instructions and example programs.

ALSO available 16K version ONLY **£4.95** which includes all the above PLUS:
GOTO's and GOSUB's included in line renumber.
Search for and list every line containing specified character.

ZX80 — PROGRAMMABLE MOVING DISPLAY (4K-ROM only) **NOW ONLY £3.95**
Cassette with 1K, 2K versions and 3 example programs plus FULL documentation

16K RAM pack
black case, fully tested and guaranteed
(please fllow 14 days for delivery)
Full refund is not delighted.

WHY PAY MORE!

£35

OVERSEAS CUSTOMERS PLEASE NOTE Payment must be made in Sterling by International Money Order (available at your bank). Please add 50 pence to cover overseas postage. (£2 RAM pack)

ZX81
in
EDUCATION

. . . is the prime concern of **EZUG**, the Educational ZX80/1 Users' Group.

* Bimonthly newsletter — £2.50 p.a.
* Quality educational software written by teams of teachers — s.a.e. for list.
* Complete (?) directory of suppliers for the ZX market (end January) — £1.00

EZUG has a thousand members. Should you be one?

EZUG
Highgate School
Birmingham B12 4DS

ACORN ATOM

Special Offer
Christmas Prices

Atom kit with 12k ram	£162
Atom assembled with 12k ram	£187
Games cassette Atom G1	£6
Atom Power Supply	£10

All prices fully inclusive of VAT and P&P
Please allow 28 days for delivery

ELECTRONEQUIP
128 West Street, Porchester
Hants PO16 9XE
Telephone: 0705-373455

A & F SOFTWARE

MORE NEW REAL TIME GAMES
FOR ATOM USERS

G0100 **POLECAT:** Avoid being eaten by the polecat searching the maze for you. 5K text 6K graphics.....£4.95

G0101 **EARLY WARNING:** Destroy the attacking ICBM's using a realistic radar display and intercept missiles. 48 levels. Sound. Score and screen counters. 4K text 6K graphics.....£4.95

G0102 **MINEFIELD:** Watch out for chain-reactions as you clear the mines with your tank. Each mission becomes harder! Sound. Score and high score. 5K text ½K graphics.....£4.95

G0103 **TANGLED:** Challenge your friend or the Atom to this game of skill. The more you score the harder you find the game. Four skill levels. Sound. Individual and highest scores displayed. 5K text 6K graphics.....£3.95

E0200 **TIME TUTOR:** Teach your children the time the modern way, the program randomly selects a time and displays it on a standard clock face, responding to the students input telling the correct time if the student is wrong. Makes learning fun. Sound. Score. 5K text ½K graphics.....£3.95

*** SPECIAL OFFER *** (supplied on one tape)

Select any two programs from "Polecat", "Early Warning" or "Minefield" for only £8.50 or all three for only £10.00
All four games programs for only £12.00

"Dealer enquiries welcome"

Order Form: Send cheque/PO payable to: **"ANDERSON" to A&F SOFTWARE, 10 WILPSHIRE AVE., LONGSIGHT, MANCHESTER M12 5TL (061 248 7195)**

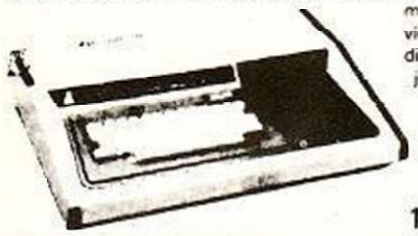
Return name and address

Code No.	Program Title	Qty	£ p

(S.A.E. for full list of available programs) Special Offer Please order on separate sheet Total

THE Video Genie EG3000 Series

WITH *16K user RAM plus extended 12K Microsoft BASIC in ROM *Fully TRS-80 Level II software compatible *Huge range of software already available *Self contained, PSU, UHF modulator, and cassette *Simply plugs into video monitor or UHF TV *Full expansion to disks, and printer *Absolutely complete just fit into mains plug.

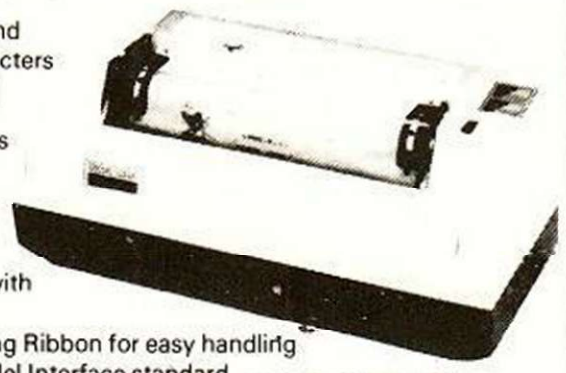


16K **£299** + VAT

GP80

The most compact 80 column impact graphic-dot printer available - at a very compact price

by seikosha



Graphics, Normal and Double- Width Characters can be printed on the same line. Pine Feed Tractor is equipped as standard.
Two Line-Feed Commands (1/6 and 1/9 inch)
Print on Plain Paper with two copies
Continuous Self-Inking Ribbon for easy handling
Centronics type Parallel Interface standard
Wide Range of Optional Interface Boards
Self-Test Programme standard

£225 + VAT

SUPERBRAIN

SuperBrain's CP/M operating system boasts an overwhelming amount of available software in BASIC, FORTRAN, COBOL, and APL. Whatever your application. . . General Ledger, Accounts Receivable, Payroll, Inventory or Word Processing, SuperBrain is tops in its class.

320K £1850 700K £2400
1.5Mb £2750

COMMODORE COMPUTERS

PET 8K	£415
PET 16K	£525
PET 32K	£650
PET 8032	£895

DISK DRIVES

4040	£695

PRINTERS

EPSON TX80B (inc. I/F & cable)	£299
EPSON MX80T	£395
ANADEX DP8000	£495
ANADEX DP9500	£895
ANADEX DP9501	£995

VIDEO MONITORS

10" BLACK & WHITE	£85
10" GREEN SCREEN	£95

Aculab

Floppy Tape
The tape that behaves like a disk.

Connects directly to TRS-80 level 2 keyboard. Operating and file handling software in ROM 8 commands add 12 powerful functions to level 2 BASIC. No buttons, switches or volume controls. Full control of all functions from keyboard or program. Maintains directory with up to 32 files on each tape.

for all TRS 80 & Video Genie owners

TRS80 version: £165
Video Genie : £170

Please add £10 Securicor delivery charge to all computers etc.
Plus 15% VAT on all prices.

Acorn Atom

Unique in concept — the home computer that grows as you do!

Special features include
***FULL SIZED KEYBOARD**
***ASSEMBLER AND BASIC**
***TOP QUALITY MOULDED CASE**
***HIGH RESOLUTION COLOUR GRAPHICS**

Simple to build, simple to operate. A powerful, full facility computer with all the features you would expect.
Just connect the assembled computer to any domestic TV and power source and you are ready to begin.
Full-sized QWERTY keyboard 6502 Microprocessor Rugged injection-moulded case 2K RAM 8K HYPER-ROM 23 integrated circuits and sockets Audio cassette interface UHF TV output Full assembly instructions

£120 + VAT

The Second Generation Personal Computer

Highest performance·lowest price

*48K (8080A)
*16 Colours or shades of Grey
*Multiple High Resolution Graphics Modes (64 x 71, 129 x 159, 255 x 335)
*Character mode (60 x 24)
*Split Screen Modes
*Full ASCII Upper & Lower Character Set
*Unique graphical — Sound Commands for Smooth Music, random frequencies & enveloped sound!
*RS232 I/F at only + VAT

DAI Personal Computer £595

Paper Tiger 460

The Paper Tiger 460 sets new standards by incorporating many features previously only available on units costing much more.

Features like a specially developed nine wire 'staggered column' head which overlaps the dots of each matrix character with just one pass of the printhead giving a dense, high quality print image without reducing the units 160 c.p.s. print speed.

It also offers a bi-directional logic seeking device to enhance its print optimisation characteristics and wide range of 'print versatility' features such as mono or proportional spacing, automatic justification, programmable horizontal and vertical tabbing, and 'fine' positioning for word processing applications.

£795 + VAT

Paper Tiger 560

The Paper Tiger 560 is the first printer which bridges the gap between conventonal matrix and 'daisy wheel' types offering quality printing at a relatively low price.

Full 'width' 132 column printing at 160 c.p.s., a unique nine wire 'staggered' print head, bi-directional printing, an inbuilt tractor feed and a host of selectable features set it apart from ordinary matrix printers.

Plus for even greater versatility a full dot plot graphics facility if supplied which includes a 2K buffer.

£995 + VAT

Books & bits

Books — Manuals — Diskettes — ribbons — Paper — chips (2114 x 2 1K) £4 pair.
RS232 to Centronics interfaces £40 etc. etc.
A variety of second-hand computer equipment usually available, spares, repairs and service.

MicroStyle

29 Belvedere, Lansdown Road, Bath BA1 5HR
Telephone: (0225) 334659

Developing software for easy learning

Educational programming calls for a sensitive mixture of skills, which combines the experience of both teachers and computer specialists. Eric Deeson analyses a computer-assisted learning problem and shows how a little care in formulating the program goes a long way in helping pupils to get the most out of the school computer.

IN MY PREVIOUS education piece, December, 1981, I tried to set out the different ways in which the computer can help the task of the teacher. I think it is worth reminding ourselves of the main categories of educational computing:

- Awareness: the aim is to maximise children's and adults' familiarity with computers and their uses. Simple programs can model many of those applications.
- Computer studies: work with the hardware as the apparatus of formal examination-orientated computer-science teaching.
- Computer-assisted learning (CAL): in which computer power is one of the many resources available for its effective teaching in most schools.
- Administration: with the computer aiding the general running of a school as in the case of any other business. Special packages are being developed.
- Data capture and process control: again, helping, as in any other business, with equipment interfacing.

What is also significant is that many people are buying micros for their homes with the main aim of helping their children with school work.

I think it is important to state that I do not believe that good teaching software can be written by any one individual. The ideal approach is to have a two-person team — a good programmer, expert with the micro in question, and a good teacher, expert in the subject in question.

Much educational software advertised is prepared by individuals rushing into a potential ground-floor gold-mine without those two different types of expertise.

The listings in this article are in ZX-81 Basic. Note that underlined material means inverse display. Although attractively laid out on the screen, a program made up of pages like those in program 1 is not a very helpful teacher. It is slightly better than a crude test which would simply count the correct answers to give a final score. At least it indicates whether the response is correct or not, and gives the correct answer. We would call a program like this a drill. It would be of use mainly in revision.

Figure 1. The questions displayed by program 1 and, below, the response to a wrong answer.

```
TYPE YOUR NUMBER BY YOUR ANSWER.

WHICH COMPLETES THE SENTENCE?

A.  OHMS LAW DEALS WITH
   1 CONDUCTORS
   2 INSULATORS
   3 SEMI-CONDUCTORS
   4 METALS.


L
```

```
NO

OHMS LAW DEALS WITH METAL.
```

```
                    OHMS LAW

   FIRST STATED IN 1840, THIS MAJOR LAW OF PHYSICS IS
CONCERNED WITH ELECTRIC CURRENTS IN PURE METALS.  WE
CALL THESE OHMIC CONDUCTORS.

THE LAW RELATES THE CURRENT IN A METAL SAMPLE TO THE VOLTAGE
BETWEEN ITS ENDS.

   HERE IS THE LAW

THE CURRENT IN A METAL SAMPLE AT CONSTANT TEMPERATURE IS PROPORTIONAL
TO THE VOLTAGE BETWEEN ITS ENDS.

PRESS N/L TO GO ON.

"L"
```

Figure 2. Improved display in response to a correct answer.

Figure 3. Output from program 2 to reinforce a correct answer and help pupils who guessed.

```
YES
OHMS LAW DEALS WITH METALS.

  THE LAW RELATES THE CURRENT
IN A METAL SAMPLE TO THE VOLTAGE
BETWEEN ITS ENDS.

  AN INSULATOR DOES NOT PASS
CURRENT.  OHMS LAW CAN SAY
NOTHING ABOUT INSULATORS THEN.

  THE BEHAVIOUR OF SO-CALLED
SEMI-CONDUCTORS CAN BE COMPLEX.
WE SHALL DEAL WITH THEM LATER.

THERE ARE OTHER CONDUCTORS
THAN METALS.  SOLUTIONS OF SOME
COMPOUNDS ARE AN EXAMPLE.  THESE
DO NOT ALL OBEY OHMS LAW.

OHMS LAW DEALS WITH METALS.
PRESS N/L TO GO ON.

"L"
```

A true CAL program has the following additional features:

- Some text is presented for study before each self-assessment question.
- Correct answers are reinforced more strongly than in the program 1 — at least explaining why the wrong answers are wrong.
- Incorrect responses lead to more help — a fuller explanation of the relevant part of the original text — and the user would have another attempt at the question.

Figure 2 shows a possible first page of such a teaching program, designed to meet the first of these three requirements. How, then, can be reinforce correct answer more strongly than before? The need for this should be obvious — a person using the program may

(continued on next page)

Program 1.

```
 01  LET A$ = " OHMS LAW "
110  GOSUB 1000
120  PRINT AT 10, 0; "A.   OHMS LAW DEALS WITH"
130  PRINT "     1     CONDUCTORS"
140  PRINT "     2     INSULATORS"
150  PRINT "     3     SEMI-CONDUCTORS"
160  PRINT "     4     METALS"
170  GOSUB 1050
180  IF A = 4 THEN PRINT "YES"
190  IF A<>4 THEN PRINT "NO"
200  PRINT "OHMS LAW DEALS WITH METALS."
210  GOSUB 1100
250  (start next question)
999  STOP
1000 REM HEADINGS
1010 PRINT TAB 11; A$,,,
1020 PRINT "TYPE THE NUMBER BY THE ANSWER",,,
1030 PRINT "WHICH COMPLETES THE SENTENCE?"
1040 RETURN
1050 REM RESPONSE
1060 INPUT A
1070 IF A<1 OR A> 4 THEN GOTO 1060
1080 CLS
1090 RETURN
1100 REM CONTINUE
1110 PRINT AT 21, 0; "PRESS N/L  TO GO ON."
1120 INPUT A$
1130 CLS
1140 RETURN
```

(continued from previous page)

have guessed the answer, used a pin to select the response, or made a typing slip. Even if he knew the answer, he needs real reinforcement and perhaps extra information, too.

Figure 3 shows a more suitable response to a correct answer. As you can see from program 1, in our first version, a correct response would have been followed only by

YES
OHMS LAW DEALS WITH METALS.
. . .
PRESS N/L TO GO ON.

A display such as figure 3 following a correct response

- Strongly reinforces that correct response, whatever caused it
- Gives help to those who guessed or mis-typed
- Gives extra information to those interested.

Of course such a display would help those who gave any wrong response. Indeed, the way I have written the program so far, with figure 3 derived from lines 202 to 207, those people would obtain the same display, but with "No" at the top rather than "Yes". We could certainly use it for them, adding a line 208 to return to the question on the previous page.

In this case, that approach to meeting the third requirement of CAL would not be too bad. Of course, it also saves a good deal of memory and programming time. All the same, a good teacher — and thus a good teaching program — should give a different, detailed follow-up to each incorrect response, before giving the user another go. To the programmer, the problem that follows this requirement is one of cost — cost in memory space.

A significant way of saving memory in a case like this is to assign to string variables any lengthy messages which may appear more than once. It is more efficient to have three lines like

LET A$ = "message" — PRINT A$ — PRINT A$

than two like

PRINT "message"

In our example program, it is likely that Ohm's law will need to be displayed on a number of occasions. Putting it in a string variable will lead to an enormous saving in time and memory. Program 2 includes all these points.

To summarise, the difference between software in the form of program 1 and program 2 is the difference between a casual teacher and a concerned one.

A good teacher does more than say "right" or "wrong" to the answer to a question. He will reinforce correct answers and check why they were given. He will give extra information for wrong answers and ask the questions again.

A good CAL program must do the same. To write such a program is not easy, but the result will do the job well.

There are other things a good teacher does which have not been demonstrated in this program. In particular the teacher gives information by pictorial as well as verbal means. A program should make much use of graphics to convey concepts and explanations.

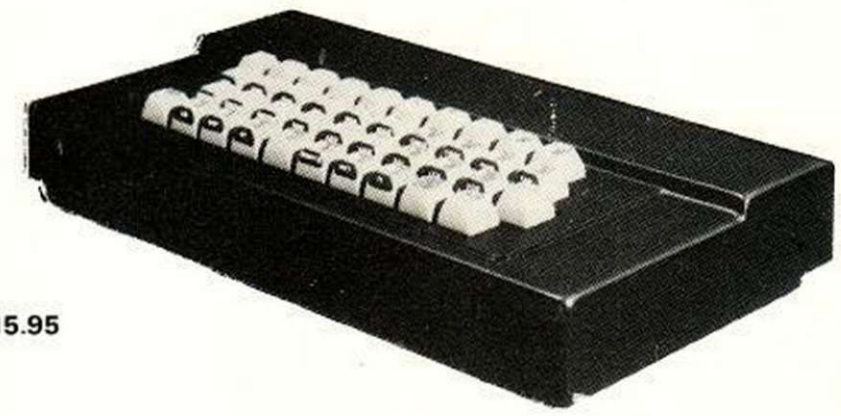
Program 2.

```
  1  LET A$=" OHMS LAW "
  2  LET B$=" OHMS LAW DEALS WITH METALS."
  3  LET C$=" THE CURRENT IN A METAL SAMPLE
     AT CONSTANT TEMPERATURE IS PROPORTIONAL
     TO THE VOLTAGE BETWEEN ITS ENDS."
  4  LET D$=" THE LAW RELATES THE CURRENT IN
     A METAL SAMPLE TO THE VOLTAGE BETWEEN ITS
     ENDS."
  5  LET E$=" AN INSULATOR DOES NOT PASS CURRENT.
     OHMS LAW CAN SAY NOTHING ABOUT INSULATORS THEN.
  6  LET F$=" THE BEHAVIOUR OF SO-CALLED SEMI-CONDUCTORS
     CAN BE COMPLEX.  WE SHALL DEAL WITH THEM LATER."
  7  LET G$=" THERE ARE OTHER CONDUCTORS THAN METALS.
     SOLUTIONS OF SOME COMPOUNDS ARE AN EXAMPLE.  THESE
     DO NOT ALL OBEY OHMS LAW."
  8  LET H$=" HERE IS OHMS LAW AGAIN:"
 20  PRINT TAB 11;A$
 30  PRINT  ,," FIRST STATED IN 1840, THIS MAJOR LAW OF
     PHYSICS IS CONCERNED WITH ELECTRIC CURRENTS INPURE
     METALS.  WE CALL THESE  OHMIC CONDUCTORS."
 40  PRINT ,, D$
 50  PRINT ,, "  HERE IS THE LAW:"
 60  PRINT ,, C$
 70  GOSUB 1100
110  GOSUB 1000
120  PRINT AT 10,0;"A.  OHMS LAW DEALS WITH"
130  PRINT " 1 CONDUCTORS",," 2 INSULATORS",,"
     3 SEMI-CONDUCTORS"," 4 METALS"
170  GOSUB 1050
180  IF A=4 THEN PRINT "YES"
190  IF A<>4 THEN PRINT "NO"
200  PRINT B$
201  IF A<>4 THEN GOTO 200+A*10
202  PRINT ,,D$
203  PRINT ,,E$
204  PRINT ,,F$
205  PRINT ,,G$
206  PRINT ,,B$
207  GOSUB 1100
208  IF A <>4 THEN GOTO 110
209  GOTO 250
210  PRINT ,,G$
211  PRINT ,,H$
212  PRINT ,,C$
213  GOSUB 1100
214  GOTO 110
220  PRINT ,,E$
221  PRINT ,,H$
222  PRINT ,,C$
223  GOSUB 1100
224  GOTO 110
230  PRINT ,,F$
231  PRINT ,,H$
232  PRINT ,,C$
233  GOSUB 1100
234  GOTO 110
250  REM START NEXT FRAME
251  PRINT  "START OF NEXT FRAME"
999  STOP
1000 REM HEADINGS
1010 PRINT TAB 11;A$,,
1020 PRINT "TYPE THE NUMBER BY YOUR ANSWER."
1030 PRINT ,,,,"WHICH COMPLETES THE SENTENCE?"
1040 RETURN
1050 REM RESPONSE
1060 INPUT A
1070 IF A<1 OR A>4 THEN GOTO 1050
1080 CLS
1090 RETURN
1100 REM CONTINUE
1110 PRINT AT 21,0;"PRESS N/L TO GO ON."
1120 INPUT A$
1130 CLS
1140 RETURN
```

Fuller FD System for ZX80/81

The Fuller FD System is not a ZX80 81 'add on' but uses the micro board at the heart of a more powerfull system, allowing the user to expand with the system or stop with a standard keyboard & case and using existing Sinclair 16K RAM pack etc, either way you only need a screwdriver to assemble the built items, the FD Keyboard simply plugs into the ZX81 which is screwed in position in the FD case, ZX80 installation requires soldering to the keyboard, we will carry out this work at a fixed charge of £10. SAE will bring you details of our products. Have your ZX81 Kit built by us FREE when you buy The FD Keyboard, Case and Power Supply at £42.95 + £2.25 p & p

- FD Keyboard Kit £18.95
- FD Keyboard Built £24.95
- FD 16K RAM Board £39.95
- Above items + 80p p&p
- FD Keyboard/Motherboard add £15.95 to Keyboard price
- FD Case £11.75 + £1.25 p&p



To **Fuller Micro Systems**
Sandfield Park East
Liverpool L12 9HP

tick ZX80 ☐ 81 ☐

Please send me

I enclose a cheque/po for

Name

Address

aculab floppy tape,

The tape that behaves like a disc,
For TRS-80 LEVEL II and Video Genie.

Connects directly to TRS-80 Level 2 Keyboard. Operating and file handling software in **ROM**. 8 commands add 12 powerful functions to Level 2 **BASIC**. No buttons, switches or volume controls. Full control of all functions from Keyboard or program. Daisy chain multiple drives. Certified digital tape in endless loop cartridges. Reads and writes in **FM** format at 9000 Baud. Soft sectored with parity and checksum error detection for highly reliable operation—just like discs. Maintains directory with up to 32 files on each tape, tapes may be write-protected. Supports Basic and machine-language program files, memory image and random access data files. 12 character filespecs—: **"FILENAME/EXT:d"** (d is drive no. 0—7). Automatic keyboard debounce. Full manual with programming examples and useful file-handling routines.

COMMANDS (usually followed with a filespec and possible parameter list).
@SAVE, @LOAD, @RUN —for **BASIC** programs, machine language programs and memory image files. **@GET, @PUT** —moves a 256-byte record between a random access file and **BASIC's** data buffer. **@KILL** —removes a file from the directory and releases tape sectors for immediate re-use. **@LIST** —displays file directory along with sector allocation and free sectors. **@NEW** —formats tape and creates a blank directory.

Master drive with PSU, Manual and a selection of tapes.
For TRS-80 £169-00, for Video Genie £174-00.
Slave drives £125-00. (add £2-00 p.p. + vat).
(Export orders pp charged at cost)

For further information, Telephone 0525 371393

aculab Ltd.
24 Heath Road, Leighton Buzzard, Beds. LU7 8AB

HOW TO TACKLE VIC COLOUR AND SOUND

Despite the fact that Vic-20s are now appearing on the market in large volumes, software for the £200 Commodore machine is still in short supply. To give you some ideas for writing your own programs, Tim Hartnell presents subroutines which generate sound and colour.

LET US LOOK at some of the colour-graphics functions. Enter this program, run it, then examine the listing to see what it is doing:

```
10  FOR J = 8 TO 127 STEP 17
20  POKE 36879,J
30  PRINT "CLR NEXT COLOUR"
40  INPUT A$
50  NEXT J
```

This shows Poke in use to create a series of different colours. Location 36879 is one of the Vic system variables. It is used to store two pieces of information: the colour of the screen, and the colour of the border. By incrementing our For-Next loop in steps of 17, we are changing both the screen-colour and the border-colour together.

Change line 10 to

```
FOR J = 136 TO 248 STEP 16
```

Now notice that the screen changes but the border does not. Note that eight new colours have been generated — orange, light-orange, pink, light-cyan, light-purple, light-green, light-blue and light-yellow.

To discover what number you have to Poke into 36879, let S equal the colour of the screen, and let B equal the colour of the border.

Use the numbers given here:

Screen	$	Border	B
Black	0	Black	0
White	1	White	1
Red	2	Red	2
Cyan	3	Cyan	3
Purple	4	Purple	4
Green	5	Green	5
Blue	6	Blue	6
Yellow	7	Yellow	7
Orange	8		
Light-orange	9		
Pink	10		
Light-cyan	11		
Light-purple	12		
Light-green	13		
Light-blue	14		
Light-yellow	15		

and use the formula

```
16*S + B + 8
```

to combine them. Thus to obtain an orange screen with a white border, just use the statement

```
POKE 36879, 16*S + 1 + 8.
```

Try this:

```
10  INPUT "CLR FIRST COLOUR";S
20  INPUT "SECOND COLOUR";B
30  POKE 36879, 16*S + B + 8
40  GOTO 10
```

Run it and input number from the tables. Now change line 30 to

```
POKE 36879, 16* S + B
```

that is, within the plus eight, and run it again, inputting the same numbers.

Let us Poke into the Vic's colour memory-map area.

```
10  FOR J = 1 TO 506
20  PRINT "shift Q";
30  NEXT J
40  POKE 38400 + INT(506*RND(1)) + 1,
    INT(8*RND(1)) + 1
50  GOTO 40
```

Lines 10 to 30 fill the screen. Line 40 is the interesting one. It Pokes a random number between one and eight — this represents one of eight different colours — into one of the addresses between 38400 and 38906. They are the colour addresses for the screen — one address for each print position. Note that there are 506 such positions, since the screen is 22 by 23: Now try

```
10  PRINT MID$("RED CYN PUR GRN BLU
    YEL",INT(6*RND(1)) + 1, 1); "shift Q";
20  GOTO 10
```

Line 10 is rather clever — the first part selects a new colour at random. Notice how the function Mid$ is used to select a single character from the string of colour controls.

The core of this program is simple. Feed it into your computer and after pressing Run, input any six letters and/or spaces, then press Return.

```
10  INPUT A$
20  FOR J = 1 TO 75
30  PRINT A$;
40  NEXT J
```

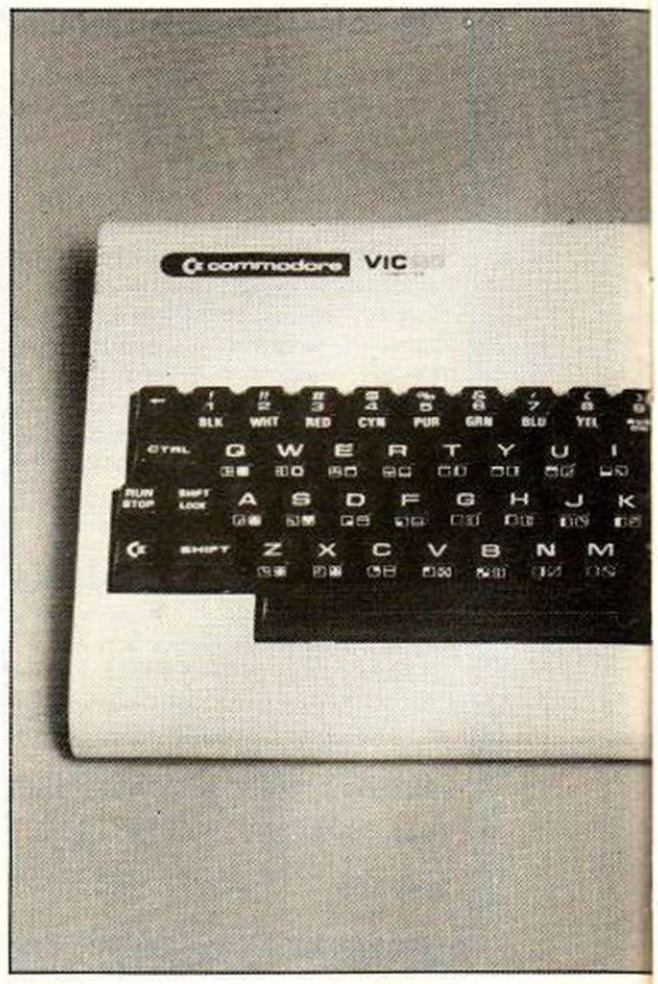
You can run this program, which is surprisingly effective, using any combination of letters, numbers and symbols. You will find that one or two spaces, instead of letters, enhance the pattern produced. Try a few more patterns, using spaces, letters like M and W, the $ sign, the numbers 6 and 9 and the graphics symbols.

Write a routine around the core program to include: a title; instructions; and the chance to form anothern pattern without having to return to command mode and press Run again. One way — and there are many — is as follows:

```
1   PRINT, "PATTERNS"
3   PRINT
6   PRINT "PRESS ANY COMBINATION OF
    6 LETTERS, one space SYMBOLS AND
    SPACES . . ."
8   PRINT
10  INPUT ". . . AND I WILL PRINT A
    PATTERN";A$
15  PRINT "CLR"
20  FOR J = 1 TO 75
30  PRINT A$;
40  NEXT J
50  PRINT
60  INPUT "DO YOU WANT ANOTHER
    GO?"; B$
70  PRINT "CLR"
80  IF B$ = "YES" THEN 6
90  PRINT "OK, space SEE YOU LATER, four
    spaces ARTIST"
100 END
```

This is an addictive program. The simplest combination of letters produces almost three-dimensional patterns. If you load this program for one of your friends to try, be prepared to wait a long time before you are allowed to use the machine again. For a colour pattern, add the lines

```
25 ON INT(8*RND(1)) + 1 GOSUB 120, 140, 160,
   180, 200, 220, 240, 260
120 PRINT "BLK";
130 RETURN
140 PRINT "WHT";
150 RETURN
160 PRINT "RED";
170 RETURN
180 PRINT "CYN";
190 RETURN
200 PRINT "PUR";
210 RETURN
220 PRINT "GRN";
230 RETURN
```



```
240  PRINT "BLU";
250  RETURN
260  PRINT "YEL";
```

Line 25 means if the random number expression is 1 then Gosub 120; if the random number is 2 then Gosub 140, and so on up to Gosub 260. Look at the subroutines themselves. You will need to use the CTRL key to obtain the colour keys. For a balanced colour program, enter and run the following.

```
10 PRINT "RED"; CHR$(INT(32*RND(1)) + 96);
20 PRINT "CYN"; CHR$(INT(32*RND(1)) + 96);
30 PRINT "PUR"; CHR$(INT(32*RND(1)) + 96);
40 PRINT "GRN"; CHR$(INT(32*RND(1)) + 96);
50 PRINT "YEL"; CHR$(INT(32*RND(1)) + 96);
60 PRINT "BLU"; CHR$(INT(32*RND(1)) + 96),
70 GOTO 10
```

Try changing the comma in line 60 to a semicolon. You can make the program a little shorter using the Def statement. Add line 1 as follows:

```
1 DEF FNR(X) = INT(32*RND(X)) + 96)
```

now whenever you see the phrase

```
INT(32*RND(1)) + 96)
```

in the program, lines 10-60, replace it with

```
FNR(1)
```

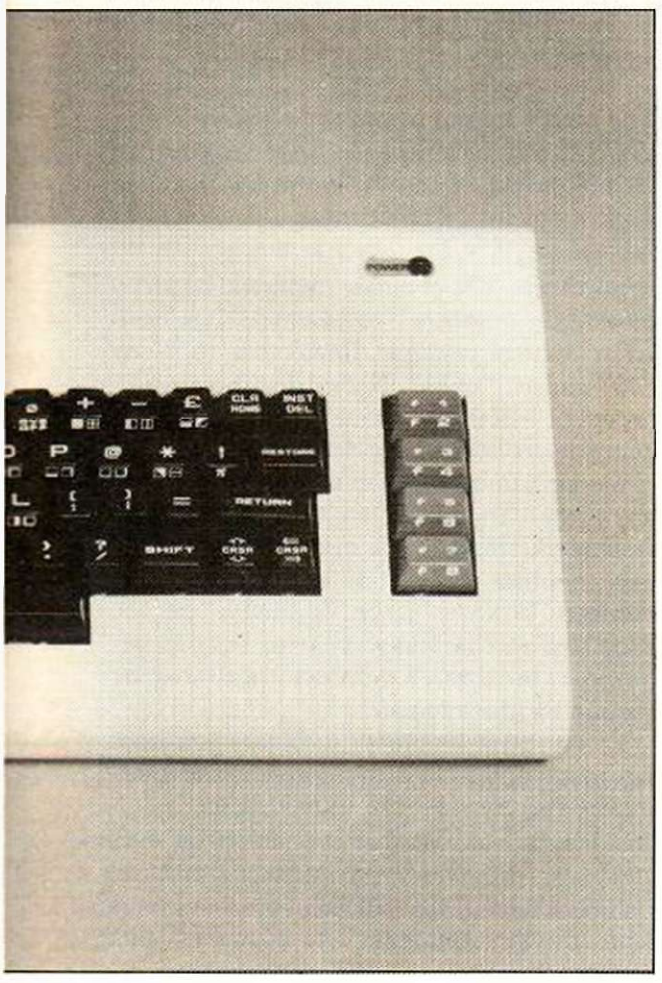
Whenever the computer encounters the word FNR it looks at line one which tells it what it means.

To explore the Vic's music-making abilities type the following lines of program:

```
10  S1=36874
20  S2=36875
30  S3=36876
40  S4=36877
50  V=36878
```

S1 stands for speaker 1, S2 stands for speaker 2, S3 stands for speaker 3, and S4 stands for speaker 4. V is for volume. The numbers after the equals sign are the Vic's music-producing numbers. You must always use these numbers when making music.

To generate sound we must use the Poke statement. Let us first see how to generate silence. Add the following lines — these form a subroutine:



```
500  FOR A=S1 TO V
510  POKE A,0
520  NEXT
530  RETURN
```

Notice that we have Poked all four speakers, and the volume, with zero. Add the following lines and then run the program.

```
100  GOSUB 500
110  POKE V,5
120  FOR A=128 TO 255
130  POKE S1,A
140  FOR B=1 TO 50: NEXT B
150  NEXT A
160  GOSUB 500
170  END
```

The number 5 we Poked into V was the volume level. The number we Poked into S1 was the tone. You should have discovered this by running it. Change line 130 to Poke S2,A and run it again. Change it to Poke S3,A and run it once more. For the biggest surprise of all, make line 130 Poke S4,A and run it again. S1, S2 and S3 are there to make music — S4 produces noise.

Type New. Now input the following program:

```
10   READ N
20   PRINT N
30   GOTO 10
9000 DATA 17,16,42,99,0,57,123
```

Line 10 instructed the computer to Read a new value into the variable N. It obtained the value 17 from the Data statement in line 9000. The next time round it Read the value 16 into N, then 42, and so on up to 123. This time when it tried to Read N it had run out of data, and so stopped with the out-of-data error message.

We can use Read and Data to help the Vic to play a tune:

```
10   S1=36874
10   S2=36875
20   S3=36876
30   S4=36877
50   V=36878
100  GOSUB 500
110  POKE V,4
120  FOR A=1 TO 16
130  READ N
140  POKE S2,N
150  FOR B=1 TO 1000:NEXT B
160  NEXT A
170  GOSUB 500
180  END
500  FOR A=S1 TO V
510  POKE A,0
520  NEXT
530  RETURN
9000 DATA 135,147,159,135
9010 DATA 135,147,159,135
9020 DATA 159,163,175,175
9030 DATA 159,163,175,175
```

This table will help you to improve the tune. It tells you what values of N you need to Poke to make the notes required.

Note	Value	Note	Value	Note	Value
C	135	C	195	C	225
C#	143	C#	199	C#	227
D	147	D	201	D	228
D#	151	D#	203	D#	229
E	159	E	207	E	231
F	163	F	209	F	232
F#	167	F#	212	F#	233
G	175	G	215	G	235
G#	179	G#	217	G#	236
A	183	A	219	A	237
A#	187	A#	221	A#	238
B	191	B	223	B	239
				C	240
				C#	241

There is no reason why the computer cannot be programmed to write its own music. Here are a few programs which do just that. Just change a few of the lines you already have then examine the listings and work out how they do it. Write a few similar programs of your own.

```
DELETE 9000-9030
DELETE 130
      140 POKE S1,INT(128*RND(1)) + 128
```

Then add the following and run the program again:

```
DELETE 120
      160 GOTO 140
```

You must press Stop to break from the program, and run 500 to stop the music. Now wipe the program, and try the following which writes its own music, and adds lighting effects:

```
10   S1=36874
20   S2=36875
30   V=36878
40   C=36879
50   POKE V,4
60   DIM N(8)
70   DIM B(4)
80   PRINT "CLR"
100  GOSUB 500
110  FOR A=1 TO 8
120  READ N(A)
130  NEXT
140  N=INT(8*RND(1)) + 1
150  B(1)=N
160  FORA=2 TO 4
170  GOSUB 400
180  B(A)=N
190  NEXT A
200  FOR A=1 TO 4
210  POKE S1,N(B(A))
220  FOR B=1 TO 2
230  GOSUB 400
240  POKE S2,N(N)
250  POKE C,16*B(A) + N
260  FOR J=1 TO 250: NEXT
270  NEXT B
280  NEXT A
290  GOTO 200
400  N=N + INT(3*RND(1))-1
410  IF N=9 THEN N=8
420  IF N=0 THEN N=1
430  RETURN
500  FOR A=S1 TO V
510  POKE A,0
520  NEXT
530  RETURN
9000 DATA 195,201,207,209,215
9010 DATA 219,223, 225
```

To break from the program, press Stop and type Goto 500. If you would like a simpler program:

```
20   S2=36875
30   V=36878
40   C=36879
50   POKE V,4
60   DIMN(8)
80   PRINT "CLR"
100  GOSUB 500
110  FOR A=1 TO 8
120  READ N(A)
130  NEXT
140  N=INT(8*RND(1)) + 1
240  POKE S2, N(N)
250  POKE C,N
260  FOR J=1 TO 1000: NEXT
290  GOTO 140
500  FOR A=S1 TO V
510  POKE A,0
520  NEXT
530  RETURN
9000 DATA 195,201,207,209,215
9010 DATA 219,223,225.
```

Again, you need to press Stop and type Goto 5000 to break from the program. ■

MACHINE CODE

STARTING WITH THE

If the merest mention of stacks, operands or mnemonics fills you with a profound sense of gloom, then you may count yourself among the growing band of those who suffer from machine-code phobia. The cure prescribed by specialist Les May consists of a salutory look at the very roots of the malady — binary, hexadecimal, bits, bytes and registers.

HIGH-LEVEL LANGUAGES are assumed to be more powerful and easier to use than low-level ones. In this high-level category we might put Pascal, Comal, Basic and Fortran. The low-level category contains the various assemblers. By powerful we usually mean that each line of program can do far more than a line of assembler. Often we also mean that it has more features, If-Then, Let, Gosub and so on.

There is, however, a penalty for this power and convenience. High-level language programs usually occupy more memory and run more slowly than low-level ones. If you have a ZX-81, you will be well aware of how quickly the 1K of memory fills. Some kinds of operations where the computer is used to control or monitor some external device may not be possible with a high-level language or, if possible, may be awkward and the response may be much too slow. One might, in these circumstances, describe a program as powerful if it could monitor the condition of a single bit every few millionths of a second and respond to any change in the same length of time. To obtain this kind of power, one has to forgo the advantages of a high-level language by going to the opposite end of the scale and learning to program in machine code.

Inside the chip

To penetrate the mystique which surrounds machine code it will be necessary to understand a little about the internal structure of computers, especially the microprocessor chip and about two less familiar numbering systems, binary and hexadecimal.

The simplest computer possible would consist of some memory, a processor chip, a program and a power supply. It would be a computer but could do little which was useful. To be of any use it must have some means of communicating with the outside world. At the simplest level this might be nothing more than a number of switches and lamps.

This is rather a tedious way of doing things and in practice a keyboard and video display would be more usual. To look at the keyboard and output data to the display, the computer will hold a program in ROM. This is usually called a monitor.

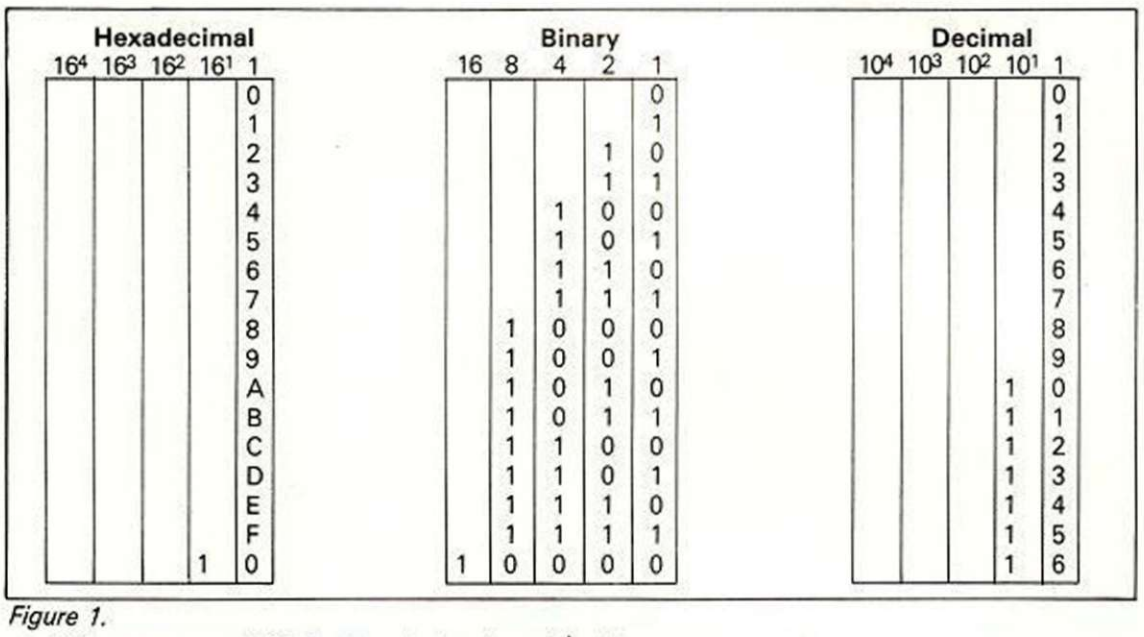


Figure 1.

Computers have been made which operate directly in the decimal system but it is much simpler to make one which operates in the binary system and to use the power of the computer to convert numbers to the decimal system when they have to be communicated to humans.

Before we look at the binary system, let us examine our familiar decimal system a little more closely. Consider the number

1 2 3

What does it mean? If you think back to your days in junior school you might remember writing it something like this

H T U
1 2 3

In other words we have

1 Hundred
2 Tens
3 Units
or 100 + 20 + 3 = 123

By a similar process any number can be oroken down into its parts. The columns can be extended as far as we wish to the left. How do we choose what the headings are? Notice that the first column is "units" or "ones". The second is "tens". Heading for the third column is "hundreds".

$$100 = 10 \times 10$$

The fourth column should, of course, be headed "thousands": notice again that

$$1000 = 10 \times 10 \times 10$$

So this is our rule: "Each column to the left is 10 times more than its neighbour on the right".

There are two points to learn here. First the number 10 is called the number base. Second for convenience $10 \times 10 \times 10 \times 10$ would be abbreviated to 10^4 — similarly, a million could be written as 10^6. Any number can be chosen as the number base.

Now that we have looked at the decimal system we are ready to apply the same ideas to the binary system. Rule three sets of five columns down a piece of paper. Ignore the left-hand sets of columns for the moment but put the words "decimal" over the right-hand set and "binary" over the middle set. Enter the correct power of 10 at the top of each of the decimal columns. When you have finished it should look something like this — see figure 1:

10^4 10^3 10^2 10^1 1

The binary system uses 2 as its number base. Write the correct power of 2 at the head of each of the centre set of columns but this time work it out first. For example,

$$2^3 = 2 \times 2 \times 2 = 8$$

Now let us look at binary numbers. Begin by putting the numbers 0 to 16 in the right-hand set or decimal columns. Remember 16 is one "10" and six "units". Notice that there are 17 numbers — learning about machine code will help you rediscover that zero is a number.

Working in base 10 you were allowed to put any of the 10 numbers, 0 to 9, in each column. In binary arithmetic you may put either of the two numbers 0 or 1 in any column. Any number, however large or small, can be expressed in the binary system, but for our purposes the first 17 numbers are all that we require for the moment.

To represent a number in binary you need far more digits than to represent the same number in decimal. This disadvantage is outweighed by the fact that the pattern of ones and zeros you write for any number is an exact representation of the pattern of ones and zeros held in the computer to represent that number.

ESSENTIALS

Writing 10000001 can at times be much more meaningful than 129. They are the same number in fact and when you Poke 129 you are putting that pattern into the computer memory. There are several points to learn about binary numbers which can be illustrated using this number

```
*      +
10000001
```

The term digit is commonly used to describe the individual symbols in decimal numbers. This is replaced by the term "bit" in binary. Also, the left-hand 1 marked with an asterisk is worth considerably more than the right-hand 1 marked with a plus sign. It is in fact worth 2^7 or 128. Hence 10000001 can be thought of as

```
1 one hundred and twenty-eight
0 sixty-four
0 thirty-two
0 sixteen
0 eight
0 four
0 two
1 one
```

or 128 + 1 = 129

To take account of this, the furthest left-hand bit is called the "most significant bit" or MSB and the furthest right-hand bit, the "least significant bit" or LSB. The maximum number you can represent with eight bits is 255. A group of eight bits like this has become known as a byte; you may also see the term "eight-bit words". Another term which may seem facetious but is, in fact, useful is "nybble" for a group of four bits.

While the bit pattern held in the computer may be most easily represented by a similar bit pattern on paper, a program written in this way would be very difficult to follow and very prone to error. What is required is a system which combines the economy of decimal digits with binary's ease of identifying the bit pattern in a byte. A moment's reflection will convince you that you require a high number base and that this base must itself be a power of two. In the very early days of microcomputers, base eight or octal was used. This made use of the eight numbers 0 to 7 and any digit in octal represented three bits of binary. For example

octal 75 = binary 111 101 = decimal 61

However, the most common microprocessors all deal with eight bits, while two octal digits cannot represent more than six bits. As a result all machine-code programming is done nowadays using numbers in base 16 or hexadecimal — figure 1.

The first 10 digits of hexadecimal are the familar digits 0 to 9 but the last six press into service the first six letters of the alphabet, A to F. In this case they represent not a sound but a number. So, 23 decimal equals 17 hexadecimal — one 16 and seven units. With two hexadecimal digits you can represent up to 256 decimal numbers and with four hexadecimal digits you can represent up to 65,536 decimal numbers. Sinclair Research has simplified matters by giving decimal equivalents of all the hexadecimal numbers between 00 and FF and forcing you to enter machine-code programs in decimal.

I mentioned that the term nybble is used for a group of four bits. You may have noticed that four bits can be represented by the 16 numbers 0 to F in hexadecimal. By considering a byte as two separate nybbles, one can quickly convert the bit pattern into a hexadecimal number using a table of bit patterns for each of the 16 numbers because the same hexadecimal digit represents the same bit pattern in each nybble.

Processing data

As we saw earlier the simplest useful computer system need consist of only memory, a microprocessor chip or CPU and some method of in- and outputting data. Unseen by the user are a collection of interconnections grouped together into two buses along which signals may flow between the CPU and memory. Some CPUs use only one bus to carry the two kinds of signal at different times.

One of the two buses carries the pattern of bits which corresponds to the address of a memory location. Perhaps the simplest analogy for memory locations is to think of a stack of trays numbered from zero in hexadecimal. The common CPUs require an address bus 16 connections wide.

Since there are 65,536 ways of arranging a pattern of 16 bits so any pattern of bits will identify only one location in the memory. 16 bits can be represented by four hexadecimal digits. Just because a CPU can address 65,536 memory locations does not mean it has to have that much memory available to it nor must the memory necessarily follow on from one area to another.

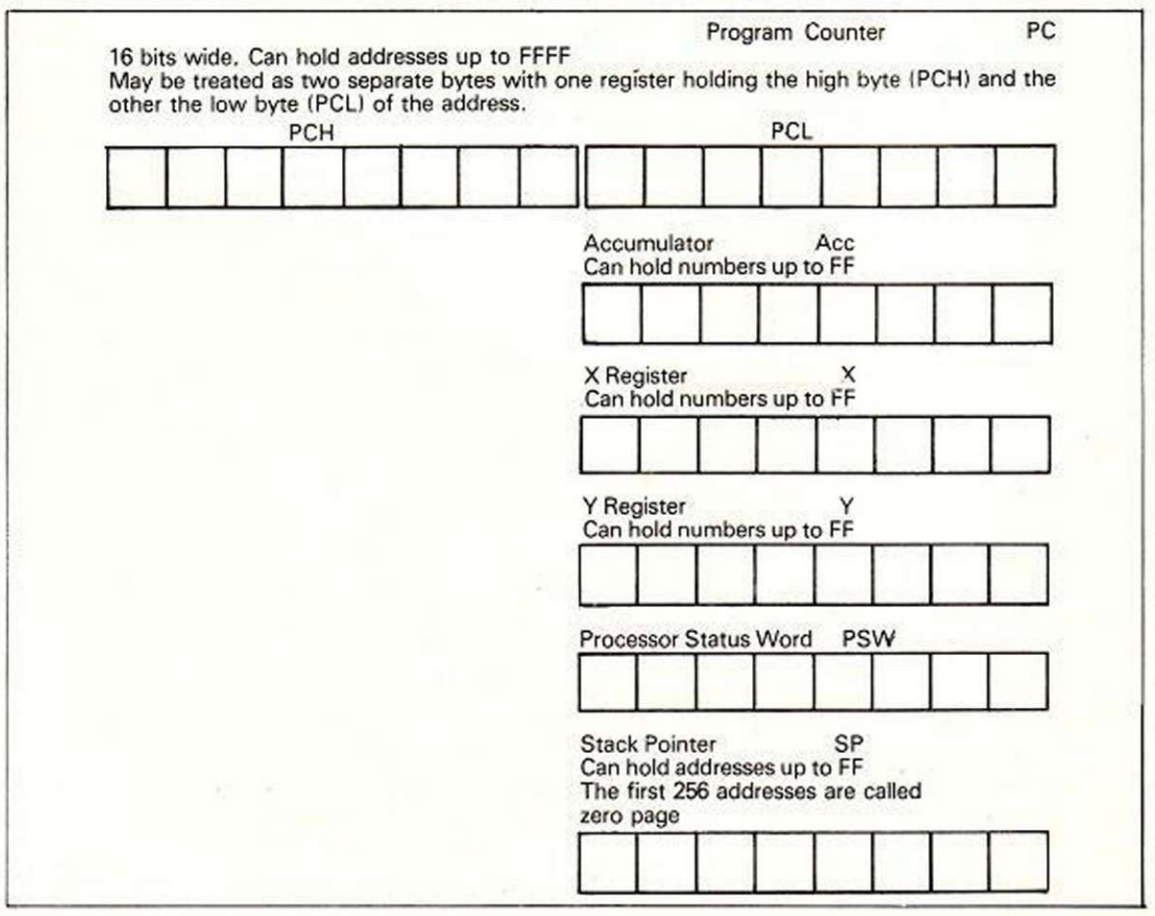
When the CPU looks to see what is in the memory, it is said to be reading. When it is storing something in memory, it is writing. Some areas of memory only permit reading and are called ROM. If reading and writing are permitted the memory is called RAM.

The way different areas of memory are allocated their functions can be seen from the memory map. Studying this carefully will tell you into which parts of the memory you can load machine code.

The second bus carries data. In this context the word data can mean a number, a bit pattern, a part of an address or an instruction. The common microprocessors have a data bus eight connections wide which allows 256 bit patterns to be carried and conveniently represented by any two hexadecimal digits.

(continued on next page)

Figure 2. Registers of the 6502. Other CPUs have different arrangements of registers.



(continued from previous page)

Inside the microprocessor are a number of registers, each capable of holding a pattern eight bits wide. You can examine and modify these registers directly or indirectly by using the monitor program which looks at the keyboard and is responsible for the display.

Some microprocessors permit two eight-bit-wide registers to be combined to form a single 16-bit-wide register. The number of registers provided depends on the chip you have in your computer. We shall be considering the 6502 chip used in the Micron, Apple, Pet and Acorn Atom, but the underlying principles can be applied to almost any other common processor.

Flags and stacks

There are seven registers in the 6502 — see figure 2. Two are combined to give a 16-bit-wide register, the program counter. This keeps track of the address of the instruction the processor is to execute next.

The accumulator, A, is the main working register — all the arithmetic and logical operations take place between the accumulator and memory. Two other registers are labelled X and Y and perform a much more limited range of operations than the A register.

They are commonly used for counting the number of times the program performs a loop or for indexed addressing.

When an instruction has been executed it is useful to have some indication of the results. This is provided by the processor-status word, PSW, held by the sixth register. The bits in the PSW are called flags and when a bit is at logic 1 the flag is said to be "set". When at logic 0 the flag is "reset". Each flag is affected by different conditions resulting from the last operation or data movement.

For example, if the hexadecimal number 2A were moved into the accumulator, the zero flag would be reset indicating that the result of the last operation was not zero. This may seem a rather trivial facility for the microprocessor to have, but programs can be made to branch depending on the result of an operation, and conditional branches are among the most powerful instructions available.

Sometimes the computer has to break from the smooth flow of a program and perform another job for a short time. For example, a burglar opening the back window has interrupted your Space Invader program, and the computer has jumped to a section of program which calls the police.

While waiting for the police you can continue your game because the first thing the police-calling program would do is store the registers A, X, Y and PSW in a portion of memory known as the "stack". The "interrupt" itself would store the program counter.

Putting things on the stack is called "pushing"; removing them is called "popping" and is done when the program called by the interrupt has completed its operation and a return to the original program is required.

The stack is also used when subroutines are called or for temporary storage of a register. The stack pointer points to the memory location where the last item was stored.

Whatever microprocessor chip your computer contains, it will have some or all of these features. Consider the following Basic program:

```
10  LET A = 255
20  LET A = A-1
30  IF A>0 THEN 20
40  PRINT A
50  BREAK
```

Although at first sight this program would look very different written in machine code, the individual steps would be remarkably similar. In a Basic program one does not have to say where in memory it is to be loaded, which register the variable A is to be put into or from where the computer is to start executing its instructions from — Run does this automatically.

Nor does one have to give the address of the subroutine which will cause the result to be displayed — Print in Basic. In machine code, however, you will have to do all these things yourself, but you are still helped a little.

Most monitors contain very useful subroutines which are available to the machine-code programmer. Careful study of a well-documented monitor will prove very valuable when writing your own programs.

We often forget that what we call programming consists of two separate and distinct processes. First, the programmer decides on the steps by which his objective is to be achieved. Then he codes it in a form suitable for the computer to understand. Carrying out the first of these we obtain something like this:

- Load register A with 255 decimal
- Take 1 from register A
- If the result is not 0, jump back to the last step
- Jump to the subroutine for displaying the result
- Break

Each line can be considered as an instruction which consists itself of two parts; an operation — do this — and an operand — to this. Such a program would be very clumsy and time-consuming to write. Recognising this, the micro manufacturers have given each operation a mnemonic code which is an easy-to-understand abbreviation.

Writing the same program in mnemonic code for the operations we have;

```
LDA
DEC
BNE
JSR
BRK
```

Most machine-code programs are written initially in this form using the appropriate mnemonics. The mnemonics must now be hand-assembled by replacing each one with its appropriate op-code. Fully assembled and with the operations and addresses added, it would look something like this — starting address 0400:

```
0400  A9 FF
0402  C6
0403  D0
0405  20 75 FE
0408  00
```

Each pair of hexadecimal digits, one byte, occupies one location in memory. Each memory location requires four hexadecimal digits to define it. Notice also that in writing the assembled program, each line contains one instruction, i.e., one operation plus one operand, which is why the program appears to skip over some memory locations.

Looking at the program one may wonder how the computer knows whether a pair of digits is intended to be an op-code or an operand: in fact, it does not know. Rather, it operates in a similar way to the single-key entry mode of the ZX-80/1 where if a key is pressed after a line number, it must be a command.

When a machine-code program is executed, the starting address is entered and the first byte encountered is treated as an op-code. In our example, executing the program from 0400 will cause the first byte, A9, to be read as an op-code meaning: "Load register A with the number which follows".

Executing the same program from 0401 will cause the first byte read, FF, to be treated as an op-code. Depending on the microprocessor concerned, FF may or may not be a valid op-code. In any event, the result would not be what was intended.

A serious machine-code programmer would invest in an assembler which is in effect a low-level language. Such a facility, held in ROM or loaded from tape as required, allows the mnemonic for the operation, followed by the operand, to be entered.

At the end of each line, the assembler translates the operation into the correct op-code and allocates it together with the operand to memory. Clearly, this procedure is less tedious than hand-assembling a program by looking up the op-code in the system manual.

Disassembler listing

Translator-type assemblers are very efficient in the use of memory and identical in length with a hand-assembled program. Some assemblers are very sophisticated and save the programmer a good deal of work in other ways, too. For example, it may be possible to give an address a label. When a branch to this address is required, the programmer need only type the appropriate mnemonic followed by the label; the assembler will then insert the appropriate number of steps the program must jump. Even if you hand-assemble all your programs, this is a useful idea to imitate.

If, for example, you require to set a time delay at a number of points in the program, then labelling this delay timer as well as specifying the address every time the subroutine is called, is an excellent way to keep track of what is supposed to be happening in the program.

If you are familiar with Basic you will know how useful it is to be able to List a program when debugging it. An assembler causes the mnemonic to be converted to the correct op-code and stored in memory. To look at the op-code in memory and convert it back to the appropriate mnemonic requires a program which does just the opposite. Not unexpectedly, it is called a disassembler and superficially it acts in a similar way to listing a Basic program. A disassembler acts independently of an assembler and can be used even with hand-assembled programs loaded from a hexadecimal.

There are horses for courses and only a masochist would write machine-code programs for number-crunching. Yet for fast-moving games or control from the computer, you will have backed a winner. ■

apple

2 year parts and labour guarantee on all Apple products supplied by LASKYS

The Product:

Apple II Europlus 48K

The Price:

NETT	VAT	TOTAL
675.00	101.25	776.25

10 Shops & Mail Order

BIRMINGHAM
19/21 Corporation Street, Birmingham, B2 4LP. Tel: 021-632 6303.
Manager: Peter Stallard. 300 yards from Bullring Centre.

BRISTOL
16/20 Penn Street, Bristol, BS1 3AN. Tel: 0272 20421
Between Holiday Inn and C. & A.

CHESTER
The Forum, Northgate Street, Chester, CH1 2BZ. Tel: 0244 317667. Manager: Jeremy Ashcroft.
Next to the Town Hall.

EDINBURGH
4 St. James Centre, Edinburgh, EH1 3SR. Tel: 031-556 6217. Manager: Colin Draper.
East end of Princes Street, St. James Centre.

PRESTON
1/4 Guildhall Arcade, Preston, PR1 1HR. Tel: 0772 59264. Manager: Jim Comisky.
Directly under Guild Hall.

MANCHESTER
12/14 St. Mary's Gate, Market Street, Manchester, M1 1PX. Tel: 061-832 6087.
Manager: Lesly Jacobs. Corner of Deansgate.

GLASGOW
22/24 West Nile Street, Glasgow, G7 2PF. Tel: 041-226 3349. Manager: David Livingstone.
Between Buchannan Street and Central Station.

SHEFFIELD
58 Leopold Street, Sheffield, S1 2GZ. Tel: 0742 750971. Manager: Justin Rowles.
Top of the Moor, opposite Town Hall.

LIVERPOOL
33 Dale Street, Liverpool, L2 2HF. Tel: 051-236 2828. Manager: Mark Butler.
Between the Town Hall and Magistrates Courts.

LONDON
42 Tottenham Court Road, London W1 9RD. Tel: 01-636 0845. Manager: Vass Demostheris

Mail Order

Microcomputers at Laskys, **FREEPOST (No stamp required), Liverpool L2 2AB**

Mail Order
If you are unable to get to a Laskys shop then you can buy your requirements from our Mail Order Department at: Microcomputers at Laskys, FREEPOST (No stamp required), Liverpool L2 2AB

Conditions of Business
1. Allow one week for personal cheques to clear
2. Add £1 p&p to orders under £10
3. Carriage free on orders over £10 within Mainland U.K. Overseas add 15%

Telephone Orders
Just give your credit card number and requirements on our 24 hour 7 day Ansaphone Service 051-236 0707 Mail Order Manageress – Lyn Major

MICROCOMPUTERS AT LASKYS

Apple peripherals are also competitively priced at Laskys, and carry the same 2 year parts and labour guarantee.

Laskys is the largest specialist Hi-Fi chain in Europe, in July 1980 they acquired Microdigital – an independent, specialist microcomputer store based in Liverpool. Since then specialist microcomputer departments have been set up within selected Laskys stores under the Microdigital name, these have now been renamed Microcomputers at Laskys.

Mail Order Form

Please send me:

Qty.		Total
	Apple II Europlus 48K – Total Price 776.25	

MAIL TO: Microcomputers at Laskys, Freepost (No stamp required), Liverpool L2 2AB
Delivery free within mainland U.K.

Name _____

Address _____

_____ Post Code _____

Tel (day) _____

Access: 5224 ☐☐☐ ☐☐☐☐☐☐ ☐☐ ☐☐
Barclaycard: 4929 ☐☐☐ ☐☐☐ ☐☐☐

American Express/Diners Club/Stereo Club No .....
Expiry date:

24 Hr Telephone Credit Card Orders 051-236 0707 Y.C/1/81

Official orders welcome with normal 30 days credit extended to bona fide commercial and government organisations.

BARCLAYCARD VISA · ACCESS · LASKYS STEREOCLUB · AMERICAN EXPRESS · DINERS CLUB INTERNATIONAL · CRA

Laskys, the retail division of the Ladbroke Group of Companies

Sinclair ZX81 Personal Comp
the heart of a system that grows with you.

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. Not surprisingly, over 50,000 were sold.

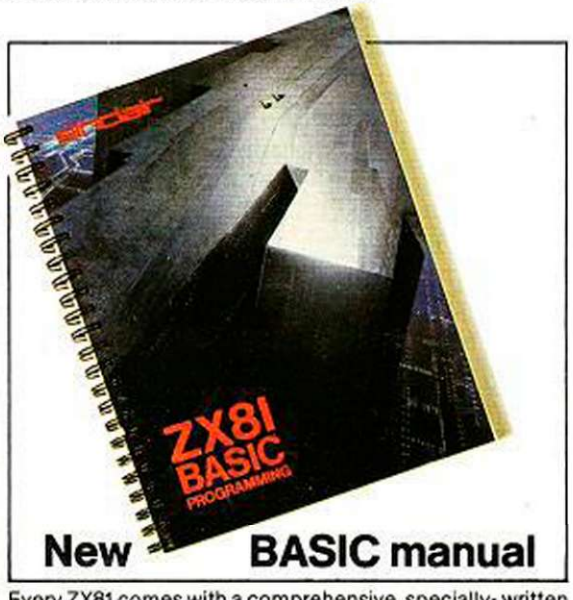
In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

Today, the Sinclair ZX81 is the heart of a computer system. You can add 16-times more memory with the ZX RAM pack. The ZX Printer offers an unbeatable combination of performance and price. And the ZX Software library is growing every day.

Lower price: higher capability
With the ZX81, it's still very simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, *and* to drive the new ZX Printer.



New BASIC manual

Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.

Kit: £49.95

Higher specification, lower price – how's it done?
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

New, improved specification

- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function – useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer.
- Advanced 4-chip design: micro-processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.

Built: £69.95

Kit or built – it's up to you!
You'll be surprised how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.

uter-

Available now- the ZX Printer for only £49.95

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alpha-numerics *and* highly sophisticated graphics.

A special feature is COPY, which prints out exactly what is on the whole TV screen without the need for further intructions.

At last you can have a hard copy of your program listings – particularly useful when writing or editing programs.

And of course you can print out your results for permanent records or sending to a friend.

Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your computer – using a stackable connector so you *can* plug in a RAM pack as well. A roll of paper (65 ft long x 4 in wide) is supplied, along with full instructions.

16K-byte RAM pack for massive add-on memory.

Designed as a complete module to fit your Sinclair ZX80 or ZX81, the RAM pack simply plugs into the existing expansion port at the rear of the computer to multiply your data/program storage by 16!

Use it for long and complex programs or as a personal database. Yet it costs as little as half the price of competitive additional memory.

With the RAM pack, you can also run some of the more sophisticated ZX Software – the Business & Household management systems for example.

How to order your ZX81

BY PHONE – Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day.

BY FREEPOST – use the no-stamp-needed coupon below. You can pay by cheque, postal order, Access, Barclaycard or Trustcard.

EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

To: Sinclair Research Ltd, FREEPOST 7, Cambridge, CB2 1YY. **Order**

Qty	Item	Code	Item price £	Total £
	Sinclair ZX81 Personal Computer kit(s). Price includes ZX81 BASIC manual, excludes mains adaptor.	12	49.95	
	Ready-assembled Sinclair ZX81 Personal Computer(s). Price includes ZX81 BASIC manual and mains adaptor.	11	69.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	10	8.95	
	16K-BYTE RAM pack.	18	49.95	
	Sinclair ZX Printer.	27	49.95	
	8K BASIC ROM to fit ZX80.	17	19.95	
	Post and Packing.			2.95

☐ Please tick if you require a VAT receipt TOTAL £

*I enclose a cheque/postal order payable to Sinclair Research Ltd, for £

*Please charge to my Access/Barclaycard/Trustcard account no.

*Please delete/complete as applicable.

Please print.

Name: Mr/Mrs/Miss

Address:

FREEPOST – no stamp needed. YOC1

sinclair

ZX81

6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Tel: (0276) 66104 & 21282.

"– the most successful show we have ever attended"

This quote from Interactive Data Systems is typical of many made by exhibitors at the 1981 Micro Show. For instance, Systime achieved signed contracts in excess of £75,000 and appointed 15 new dealers. Ingersoll also reported fantastic sales.

The 1982 exhibition is specifically designed for a business audience seriously considering the installation of a micro system or personal computers for business use within their organisation.

Many of the larger display areas have already been allocated, so if your company has not yet reserved space, please contact our Exhibition Department who will make you a provisional booking awaiting your written confirmation.

THE 1982 MICRO SHOW

11-13 May 1982
Wembley Conference Centre
London

INTERACTIVE data systems

Online Conferences Ltd
Argyle House
NORTHWOOD HILLS
Middx
HA6 1TS

Our Ref: JS/PL

Dear Jane

We have now had the opportunity to follow up the many leads we received at the 1981 Microcomputer Show, and are pleased to say that this show was, without doubt, the most successful show we have ever attended.

We have signed up several new dealers, including one in Eire, and in total the new business we found at the show could result in orders to the value of £½m over the next twelve months.

We will be back in 1982!

Yours sincerely

Jon Spencer
Marketing Director

Online Conferences Ltd., Argyle House, Northwood Hills, Middlesex, HA6 1TS.
Telephone: Northwood (09274) 28211 Telex: 923498

Write fast-moving on your ZX-81

Martin Buckeley shows you how to write a series of machine-code subroutines, culminating in a fast game of Breakout.

FOR THOSE NEW to machine code, a register comprises eight cells or bits, which represent values rising in powers of two from the right. Each register can thus hold a value between 0 and 255 depending on which cells are set — that is, those which contain ones — and those which are not — those which contain zeros.

The seven registers which can be addressed directly are identified by the letters a,b,c,d,e,h,l. Registers bc, de, and hl can operate in pairs to represent values from 0 to 65,535 — that is, 256 multiplied by the left register added to the right register. In the example, register b has the value 64, and register c the value 136, but the pair together represent the value 16,520.

b

0	1	0	0	0	0	0	0
128	64	32	16	8	4	2	1

c

1	0	0	0	1	0	0	0
128	64	32	16	8	4	2	1

Register a is an accumulator register used for additions and comparisons.

In machine code, the Z-80A is addressed directly using numbers in the range 0 to 255. The two numbers 203 (CB h) and 237 (ED h) act in a similar manner to shift keys. Used as a prefix, they extend the list of machine code commands to 559. A full list of these codes appears in appendix A of the ZX-81 manual, but here are a few examples to enlarge on the mnemonics used:

ld a,b	Load register a with the value of register b.
ld a,N	Load register a with the next number in the list.
cp N	Compare with the following number — returns a zero if true.
add a,b	Add the value of register b to register a.
inc b	Increment register b.
dec b	Decrement register b.
ld hl,NN	Load register pair hl with the values of the next two numbers.
ld de,(NN)	Load register pair de with the value held at memory location (N + 256*N)
jp NN	Jump to memory location (N + 256*N)
jpz,NN	Jump if zero to location (N + 256*N)
jpnz,NN	Jump if not zero to NN
jr DIS	Relative jump to the memory location indicated by the next number. N less than 127 jumps forward. N greater than 128 jumps 255-N backwards.
call NN	Equivalent to Basic Gosub
ret	Equivalent to Basic Return
ret z	Return if zero

Before launching into the Breakout program we ought to have a rough outline of what we require, and I propose to tackle the job under the following four headings: move ball, move bat, draw board and the scoring mechanism.

All four jobs require a routine to plot a character at a given location — the equivalent of the Print At instruction in Basic — and this will be our first subroutine. We will use registers b and c independently to hold the column and line positions, and register a to hold the character to be plotted.

(BASIC : PRINT AT c,b;CHR$ a)

The de and hl registers are used to compile the address of the memory location equivalent to the required screen position. 16396 holds the address of the start of the display file. What we require our subroutine to do is count forward 32 characters for each line, skip any end-of-line markers — 118 — and add the column position.

Now we can start programming. We need to reserve memory to hold the program and this is done as suggested by Sinclair, behind the first Rem. Switch on and key:

100 REM

followed by 340 zeros — about 10.5 lines. When your finger recovers, enter lines 900 to 980 of our code loader.

For reasons I shall explain later, we commence our subroutine at memory location 16520, so Run the program and enter 16520 to the first prompt. Now enter the code numbers in column two of the list, and the ZX-81 should print out the first two columns for you. When you reach

16552 201 C9 ret

enter 999, and the program should stop.

To test this routine, we must assign values to registers a,b, and c, and this is achieved in the next few lines. Run the program again. This time start at memory location 16514, and enter:

16514	62	ld a,N	
16515	61		Code for an 'X'
16516	6	ld b,N	
16517	0		Column number
16518	14	ld c,N	
16519	0		Line number
	000	STOP program	

If you now type

LET A = USR 16514

you should see an "X" appear in the top left of your screen. To vary its position, Poke a new line number — 0 to 15 only since 16 will crash — into 16519 and a new column number — 0 to 31 — into 16517. You can Poke any code you like into 16515.

Now that we have a plotting routine, it is time to think about how to move the ball. This is achieved by deleting the existing ball, changing the line and column position and then replotting the ball.

There are four pieces of information we require to do this, and we shall store them in the locations indicated:

Ball position	Current line number	16507
	Current column number	16508
	Horizontal direction	16514
	Vertical direction	16515

To avoid negative values, the ball direction

Driver and loader program.

```
300 CLS
310 LET A = USR 16742              REM PRINT BOARD
320 PRINT AT 17,0;"SCORE (6 spaces) BALL"
322 PRINT AT 19,0;"KEYS 1/0 MOVE BAT"
324 PRINT AT 20,0;"NEWLINE DELIVERS BALL"
330 POKE 16507, INT (RND*12)+2     REM RANDOM LINE NUMBER 2-13
340 POKE 16515,2
350 POKE 16514, INT (RND*2)*2      REM RANDOM DIRN. 0 or 2
360 POKE 16517,CODE INKEY$
370 IF CODE INKEY$=118 THEN GOTO 420
400 LET A=USR 16593
410 GOTO 360
420 IF PEEK 16518 = 252 THEN GOTO 300
430 POKE 16508,2
440 LET A = USR 16593
450 POKE 16517,CODE INKEY$
460 IF PEEK 16508=0 THEN GOTO 510
470 IF PEEK 16518 > 100 THEN GOTO 440
480 IF PEEK 16518 > 50 THEN GOTO 440
490 IF PEEK 16518 > 20 THEN GOTO 440
500 GOTO 440
510 PRINT AT 17,6;PEEK 16518
520 PRINT AT 17,16;PEEK 16519
530 GOTO 330
900 PRINT "START LOCATION"
910 INPUT A
920FOR N=A TO 16850
930 INPUT B
940 IF B>255 THEN STOP
950 PRINT AT 18,0;N;"(space)";B
960 SCROLL
970 POKE N,B
980 NEXT N
990 STOP
```

graphics

is indicated by either a 0 which decreases line/column value, or 2 which increases line/column number. To find the new ball position we will use the formula:

New Position = Old Position + Indicator − 1

Load your program and then Run. For the start location enter 16643 and all the lines up to 16680.

The next thing to consider is how to change the direction indicators. This is done in the lines 16553 to 16565, where for any given memory location in hl a 0 will be changed to a 2 and a 2 to a 0. Run the program again and with line 16553 as the start location, key in lines 16553 to 16565.

The next two sections of the program enter either the horizontal or vertical indicator locations into hl before calling the switch routine. The start location is 16566 and the routine ends at 16580.

We must now consider the conditions for switching the vertical indicator:

- The ball is in line 1
- The ball is in line 14

and those for switching the column indicator:

- The ball is in column 28
- The ball hits the bat
- It hits a front brick in the wall
- It hits a back brick in the wall

In the next section we cover these conditions and also keep a tally of deleted bricks counting 1 for a brick from the front wall and 5 for one in the rear wall. Further, we will keep a tally of balls used. So, the start location is 16681 and the codes run to 16741.

To test the program so far, we must now enter a few lines of the Basic program which will act as the controlling program. Use my line numbering as there are further lines to be inserted later.

```
300 POKE 16518, 0
310 POKE 16519, 0
330 POKE 16507, INT(RND *12)+2
340 POKE 16514, INT(RND *2)*2
350 POKE 16515, 2
430 POKE 16508, 2
440 LET A = USR 16612
460 IF PEEK 16508 = 0 THEN GOTO 510
500 GOTO 440
510 INPUT A$
520 GOTO 330
```

If everything is working, Run should produce a ball bouncing around the screen. If you have problems delete lines 930 to 960 inclusive, add

```
950 PRINT N;"space";PEEK N
```

then Goto 900 and check your listing.

Our project is now nearing completion, but as yet we still need a moving bat, the board, and a way of presenting the score.

Three CHR$ 133s make a reasonably-sized bat, and using Basic to Poke keystrokes into 16517 we can transfer bat moves into the machine-code program. We shall have to stop the bat exceeding the game area, but it will always be in column 1, so we need only store its line number — in 16516. Load the program again and Goto 900. Now enter lines 16581 to 16642.

Now enter 999 and then key this line:

```
450 POKE 16517, CODE INKEY$
```

This section of the program can now be tested by entering the Basic line

```
440 LET A = USR 16593
```

and running it. If all is well, the bat should run up and down the left-hand side of the screen.

We now arrive at the board-drawing routine. It is feasible to write this in Basic, and you might like to try it to compare execution speed. Goto 900 then and the start location is 16742. The board-drawing routine ends at 16809.

That is the end of the machine code, all that now remains is to complete the Basic driver program. The whole program is shown in listing 1. Lines 470 to 490 vary the speed of the ball and may be omitted for a faster game, or alternatively substitute:

```
470 FOR Q = 1 TO 3
490 NEXT Q
```

for a slower game. Using Pause introduces a flicker into an otherwise rock-steady performance. The addition of lines 322 and 324 make the program a little more user-friendly.

```
322 PRINT AT 19,0;"KEYS 1/0 MOVE THE BAT"
324 PRINT AT 20,0;"NEWLINE DELIVERS THE BALL"
```

You now have the basic ingredients for writing your own fast-moving games programs. A full listing of this program is available from me at 33 Stoneham Lane, Swaythling, Southampton. Please send £1 plus a stamped, addressed envelope; send an extra £1.50 if you want a cassette as well.

```
16520   38 26   ld h,N
16521    0 00
16522  105 69   ld l,c
16523  203 CB
16524   37 25   sla l
16525  203 CB
16526   37 25   sla l
16527  203 CB
16528   37 25   sla l
16529  203 CB
16530   37 25   sla l
16531  203 CB
16532   37 25   sla l
16533  203 CB
16534   20 14   rlh
16535   89 59   ld e,c
16536   22 16   ld d,N
16537    0 00
16538   25 19   add hl,de
16539   88 58   ld e,b
16540   25 19   add hl,de
16541  237 ED
16542   91 5B   ld de,(NN)
16543   12 0C
16544   64 40
16545   25 19   add hl,de
16546   17 11   ld de,NN
16547    1 01
16548    0 00
16549   25 19   add hl,de
16550   86 56   ld d,(hl)
16551  119 77   ld (hl),a
16552  201 C9   ret
16553  126 7E   ld a,(hl)
16554  254 FE   cp N
16555    0 00
16556   32 20   jrnz DIS
16557    4 04
16558   60 3C   inc a
16559   60 3C   inc a
16560   24 18   jr DIS
16561    2 02
16562   61 3D   dec a
16563   61 3D   dec a
16564  119 77   ld (hl),a
16565  201 C9   ret
16566   33 21   ld hl,NN
16567  130 82
16568   64 40
16569  205 CD   call NN
16570  169 A9
16571   64 40
16572   24 18   jr DIS
16573  116 74
16574   33 21   ld hl,NN
16575  131 83
16576   64 40
16577  205 CD   call NN
16578  169 A9
16579   64 40
16580  201 C9   ret
16581  121 79   ld a,c
16582  254 FE   cp N
16583    0 00
16584  200 C8   ret z
16585   13 0D   dec c
16586  201 C9   ret
16587  121 79   ld a,c
16588  254 FE   cp N
16589   13 0D
16590  200 C8   ret z
16591   12 0C   inc c
16592  201 C9   ret
16593    6 06   ld b,N
16594    1 01
16595   62 3E   ld a,N
16596    0 00
16597   33 21   ld hl,NN
16598  132 84
16599   64 40
16600   78 4E   ld c,(hl)
16601  205 CD   call NN
16602  136 88
16603   64 40
16604   13 0D   dec c
16605  205 CD   call NN
16606  136 88
16607   64 40
16608   13 0D   dec c
16609  205 CD   call NN
16610  136 88
16611   64 40
16612   33 21   ld hl,NN
16613  133 85
```

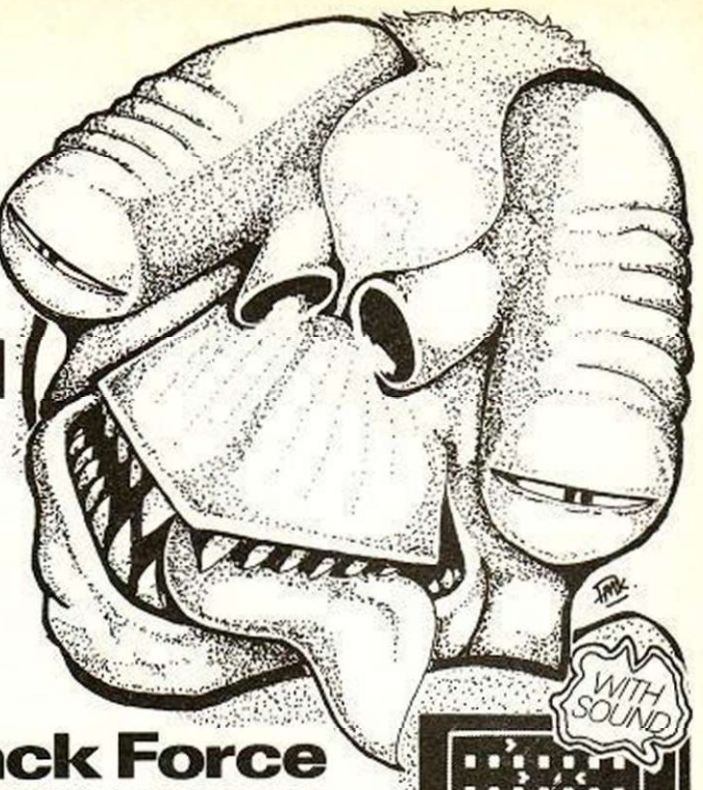
(continued on next page)

(continued from previous page)

```
16614   64 40
16615  126 7E  ld a,(hl)
16616  254 FE  cp N
16617   29 1D
16618  204 CC  call z,NN
16619  197 C5
16620   64 40
16621  254 FE  cp N
16622   28 1C
16623  204 CC  call z,NN
16624  203 CB
16625   64 40
16626   62 3E  ld a,N
16627  133 85
16628  205 CD  call NN
16629  136 88
16630   64 40
16631   12 0C  inc c
16632  205 CD  call NN
16633  136 88
16634   64 40
16635   12 0C  inc c
16636  205 CD  call NN
16637  136 88
16638   64 40
16639  121 79  ld a,c
16640   50 32  ld(NN),a
16641  132 84
16642   64 40
16643   33 21  ld hl,NN
16644  123 7B
16645   64 40
16646   78 4E  ld c,(hl)
16647   35 23  inc hl
16648   70 46  ld b,(hl)
16649  120 78  ld a,b
16650  254 FE  cp N
16651    0 00
16652  200 C8  ret z
16653   62 3E  ld a,N
16654    0 00
16655  205 CD  call NN
16656  136 88
16657   64 40
16658   17 11  ld de,NN
16659  123 7B
16660   64 40
16661   33 21  ld hl,NN
16662  130 82
16663   64 40
16664  126 7E  ld a,(hl)
16665  129 81  add a,c
16666   61 3D  dec a
16667   79 4F  ld c,a
16668   18 12  ld (de),a
16669   35 23  inc hl
16670   19 13  inc de
16671  126 7E  ld a,(hl)
16672  128 80  add a,b
16673   61 3D  dec a
16674   71 47  ld b,a
16675   18 12  ld (de),a
16676   62 3E  ld a,N
16677   52 34
16678  205 CD  call NN
16679  136 88
16680   64 40
16681  121 79  ld a,c
16682  254 FE  cp N
16683    1 01
16684   40 28  jrz DIS
16685  136 88
16686  254 FE  cp N
16687   14 0E
16688   40 28  jrz DIS
16689  132 84
16690  120 78  ld a,b
16691  254 FE  cp N
16692   28 1C
16693   40 28  jrz DIS
16694  135 87
16695  254 FE  cp N
16696    0 00
16697   40 28  jrz DIS
16698   28 1C
16699  122 7A  ld a,d
16700  254 FE  cp N
16701  133 85
16702  202 CA  jp z,NN
16703  190 BE
16704   64 40
16705  254 FE  cp N
16706    8 08
16707   40 28  jrz DIS
16708    7 07
16709  254 FE  cp N
16710  189 BD
16711  192 C0  ret nz
16712   30 1E  ld e,N
16713    5 05
16714   24 18  jr DIS
16715    2 02
16716   30 1E  ld e,N
16717    1 01
16718   33 21  ld hl,NN
16719  134 86
16720   64 40
16721  126 7E  ld a,(hl)
16722  131 83  add a,e
16723  119 77  ld (hl),a
16724  195 C3  jp NN
16725  190 BE
16726   64 40
16727   33 21  ld hl,NN
16728  135 87
16729   64 40
16730   52 34  inc(hl)
16731   62 3E  ld a,N
16732    2 02
16733   50 32  ld(NN),a
16734  131 83
16735   64 40
16736   62 3E  ld a,N
16737    0 00
16738  205 CD  call NN
16739  136 88
16740   64 40
16741  201 C9  ret
16742   62 3E  ld a,N
16743  128 80
16744    6 06  ld b,N
16745   29 1D
16746   14 0E  ld c,N
16747   15 0F
16748  205 CD  call NN
16749  136 88
16750   64 40
16751   13 0D  dec c
16752   32 20  jrnz DIS
16753  250 FA
16754   14 0E  ld c,N
16755    0 00
16756  205 CD  call NN
16757  136 88
16758   64 40
16759   14 0E  ld c,N
16760   15 0F
16761  205 CD  call NN
16762  136 88
16763   64 40
16764    5 05  dec b
16765   32 20  jrnz DIS
16766  243 F3
16767    6 06  ld b,N
16768   21 15
16769   14 0E  ld c,N
16770   14 0E
16771   62 3E  ld a,N
16772  189 BD
16773  205 CD  call NN
16774  136 88
16775   64 40
16776   13 0D  dec c
16777   32 20  jrnz DIS
16778  250 FA
16779    5 05  dec b
16780  120 78  ld a,b
16781  254 FE  cp N
16782   18 12
16783   32 20  jrnz DIS
16784  240 F0
16785   14 0E  ld c,N
16786   14 0E
16787   62 3E  ld a,N
16788    8 08
16789  205 CD  call NN
16790  136 88
16791   64 40
16792   13 0D  dec c
16793   32 20  jrnz DIS
16794  250 FA
16795    5 05  dec b
16796  120 78  ld a,b
16797  254 FE  cp N
16798   15 0F
16799   32 20  jrnz DIS
16800  240 F0
16801   33 21  ld hl,NN
16802  134 86
16803   64 40
16804   54 36  ld(hl),N
16805    0 00
16806   35 23  inc hl
16807   54 36  ld(hl),N
16808    0 00
16809  201 C9  ret
16810    0 00  nop
16811    0 00  nop
16812    0 00  nop
16813    0 00  nop
16814    0 00  nop
16815    0 00  nop
16816    0 00  nop
16817    0 00  nop
16818    0 00  nop
16819    0 00  nop
```

■

The Essential Software Company



THIS IS NOT A PRACTICE DRILL! EARTH IS BEING INVADED ON YOUR TRS80 & VIDEO GENIE

Galaxy Invasion

The newest and most exciting invaders type game yet! Cruel and crafty aliens attack Earth. You are the sole defender. As you fire your laser at the aliens they swoop down and bomb you. Exciting use of graphics! Must be seen.

TRS 80 Level I & II 16K Tape

Video Genie 16K Tape

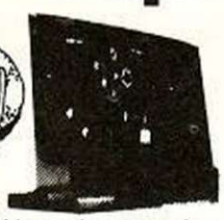
Attack Force

Dodge the alien Ramships and fire missiles to destroy them before they get you. The alien Flagship uses his deadly laser bolt to transform a Ramship into another Flagship or into your ship's double. Look out! Destroy your double and you could destroy yourself.

TRS 80 Level I & II 16K Tape

Video Genie EG3003 16K Tape

SuperNOVA



ORDER NOW

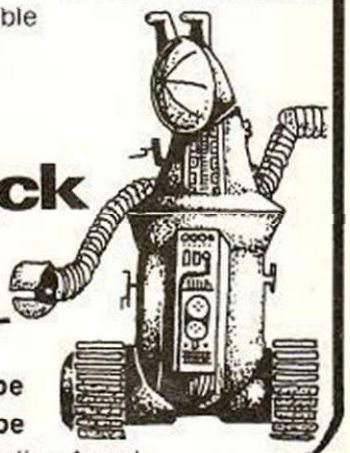
Now the amazing ASTEROIDS arcade game for your TRS 80! Your ship is floating in the middle of an asteroid belt! Your only escape is to destroy them and the crafty alien spacecraft! Blast them with your laser, thrust, rotate or hit hyperspace to survive!

TRS 80 Levels I & II 16K Tape

Video Genie 16K Tape

Robot Attack

THE GAME THAT TALKS



TRS 80 Levels I & II 16 K Tape

Video Genie 16 K Tape

The Newest and Most Astounding Arcade Game that TALKS has just Reached Planet Earth. You can't help yourself. You have to stop them at all cost. Don't let up. Written especially for high quality graphics you'll simply be dazed and excited by the action.

Cosmic Fighter

Your fighter appears below a convoy of Aliens! If you destroy them another set appears who seem to be slightly cleverer than before! Soon your space station nears but before you can dock the station comes under attack! Survival is up to you! The excitement is just beginning!!

TRS 80 Levels I & II 16K Tape

Video Genie 16K Tape

Gobble MAN

Watch out behind you! As you hurry through the maze collecting your energy modules you score points. But don't let the Gobblemen catch you. If you are crafty, sneek up behind them and neutralise them to gain extra points. Just keep a watch. When they attack you they come in fast. Just don't lose your nerve.

TRS 80 Levels I & II 16 K Tape

Video Genie 16 K Tape

3D Adventures

for TRS 80 LEVEL II 16K

3-D means that as you wander through the mazes and buildings, full screen graphic display constantly shows your position in a perspective format as though you were actually there! This "rat's eye" view adds an entirely new dimension to adventure.

English language commands can be entered at any time to manipulate your environment. The command sets are extensive and sophisticated. Dozens of objects are scattered throughout the mazes and buildings. You can pick them up, burn them, throw them, etc. You may need the sword to fight off an ugly little man. Or a steel rod to hold apart crushing walls. Deathmaze 5000 and Labyrinth allow the traditional one and two word commands. Asylum incorporates our Advanced Language Interpreter (ALI), which allows full sentence input.

Deathmaze and Labyrinth consist of over 550 locations! Asylum tops 1200 locations!

All Tapes £10 ea

ASYLUM Tape £12

THE ESSENTIAL SOFTWARE COMPANY
(Viscounti Ltd.) 01-837 3154
47 Brunswick Centre, London WC1N 1AF

I have a ..... microcomputer.

☐ Please send me your software catalogue. I enclose a stamped self addressed envelope.

☐ Please send me ..... I enclose a cheque/postal order for £ .....
(plus 50p post & packing)

Signature .....

Name .....

Address .....

Postcode .....

My ACCESS No is .....

PROJECT

DIGITISING ANALOGUE

Continuing his series on the development of process-control software, John Dawson tackles the crucial problem of converting information from external equipment into machine-readable form.

IN THE FIRST article in the series I described a very simple digital-to-analogue converter (D-A) which produced a voltage from a digital number. This article is about the reverse process, analogue-to-digital conversion (A-D), and the uses to which an A-D converter can be put for gathering data from the real world for the computer to act on.

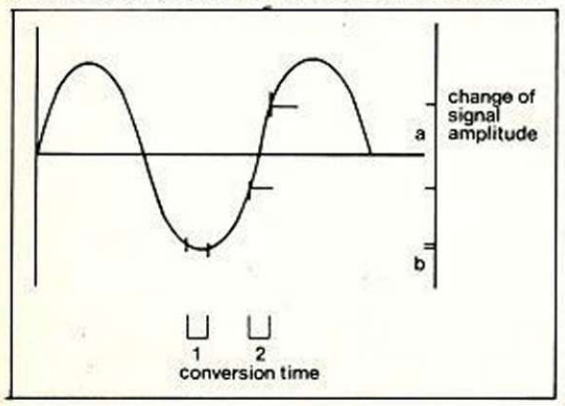
The listings give a program for setting the time on the clock program I listed last month. I have found an error in the clock software — nothing catastrophic, just that the week counter does not increment without another instruction STA WK inserted before line 150.

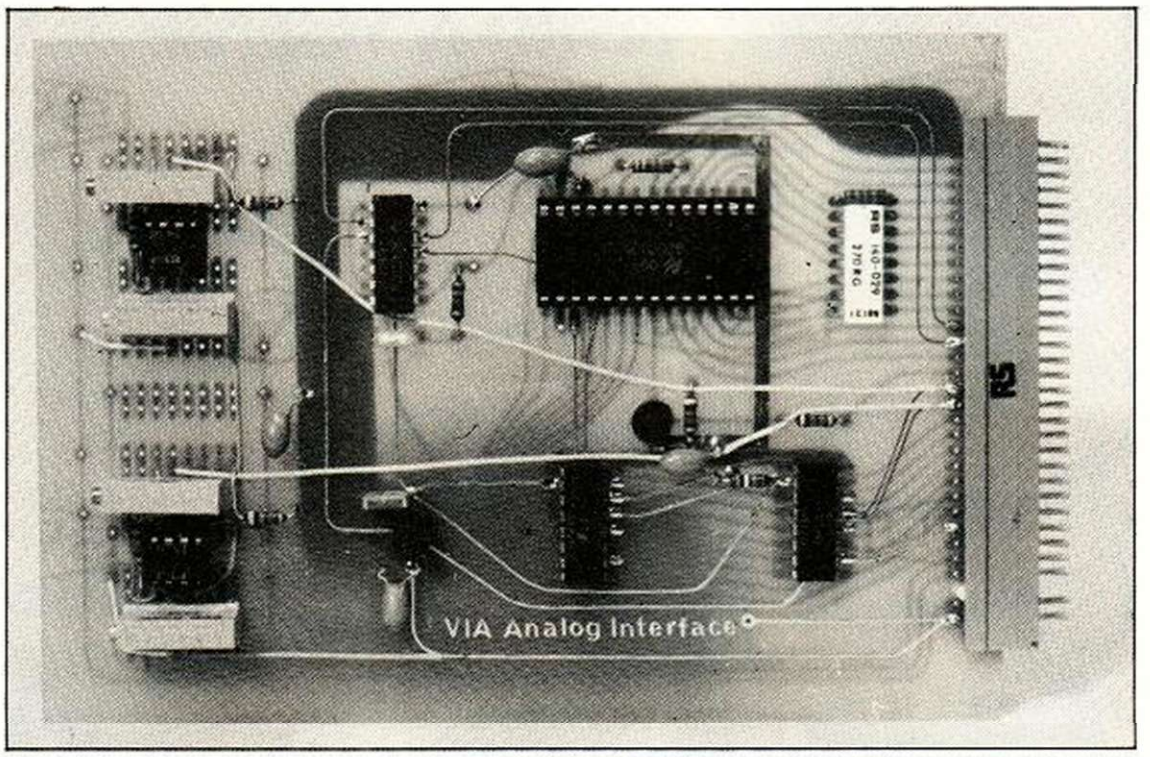
Analogue-to-digital conversion is a process in which a variable voltage is measured and described by a digital number. The analogue voltage may be steady or it may alter randomly or in a defined and regular way. The wave-form in figure 1 is a sine wave, a regular pattern which repeats itself without variation. Eight bits, one byte, can describe 256 different states and this means that analogue voltage somwhere between 0 and 2.55V can be measured to an accuracy of 10mV that is, one-hundredth of a volt.

Recently, 10-bit and 12-bit A-D converters have become less expensive and more common. They resolve or measure a signal voltage to one part in 1,000 or one part in 4,000 respectively. The increased accuracy is almost irrelevant for domestic measurements and most of the work done in school laboratories.

Most A-D converters use a technique known as successive approximation. There is, however, a second method which is faster, but more expensive, called flash conversion. Successive approximation uses a converter to produce a voltage from numbers generated by the A-D board.

Figure 1. Voltage changes more rapidly when it crosses the zero point (a) than near a peak (b).





The Original Microsystems VIA interface, with input from the multiplexer taken to the comparator.

The reference voltage is compared with the unknown, incoming analogue voltage and the A-D chip hunts for the closest match between the reference and the unknown. When all eight bits of the converter are set to the best match to the unknown voltage, the conversion is finished and the computer reads the digital number as the measurement of the analogue voltage.

Successive approximation uses one comparator circuit; in contrast, flash conversion is performed using one comparator circuit for each possible state of the output. So, for an eight-bit converter, 256 comparators would be necessary — hence the increased cost; while for a 10-bit converter, 1,024 comparators would be required. Flash converters can be used, however, for converting TV signals from one standard to another which involves working at frequencies up to 10-15MHz.

The versatile interface adaptor chip (VIA) analogue interface produced by Original Microsystems Ltd at 39 High Street, North Crawley, Newport Pagnell, Buckinghamshire, is intended for the Tangerine Microtan computer. However, the board will interface to any 6522 VIA chip and is just as suitable for the Aim 65, Acorn Atom, or the BBC microcomputer.

The board has eight unipolar analogue inputs. That means that the inputs will measure either positive or negative in relation to zero but not both, in this case 0 to +5V. There are also two D-A converters on the board and a prototyping area in which operational amplifiers or other circuits can be hand-wired.

The board is made of glass fibre and is double-sided but not through-plated. The board fits comfortably into the Tangerine rack and all the input and output connections are brought to a standard 0.1in. pitch, 32-way connector. The advantage of this system is that you can move the board from one computer to another by unplugging it and changing the connector for one which has been wired for the VIA outlet of the new machine.

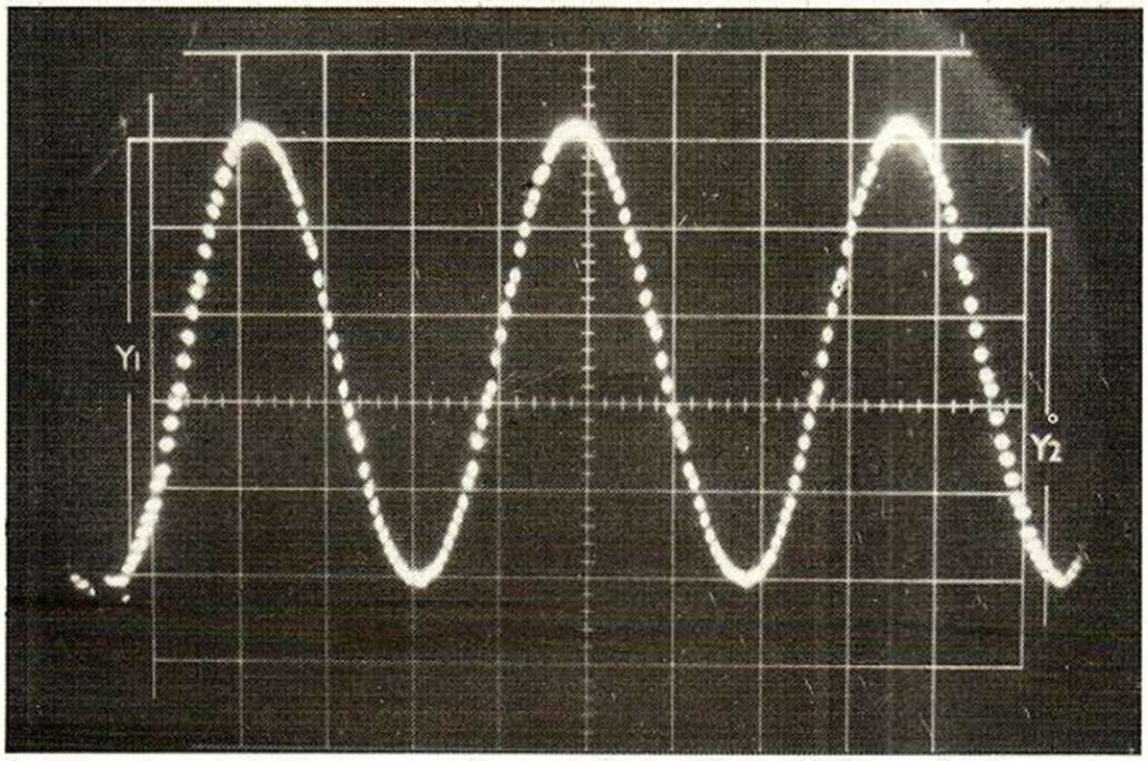
In a normal form the board costs £95; the version supplied for this review had two CA-3140 optional amplifiers added to the outputs from the Ferranti D-A converters. The ADC-0809 integrated circuit takes between 100 and 150μs. to read an analogue voltage and return the digital equivalent. The input is taken straight from the multiplexer, the circuit that selects one of the eight inputs, to the comparator.

There is no provision in this chip for sampling and then holding the input while the conversion is carried out. The consequence is that for an accurate conversion, the input must be stable to within a small fraction of the input voltage for 100μus. at least.

The calculations to find the exact limits at which the chip will work accurately are set out in the *Data Conversion Handbook* by Donald S Bruck but it may be reduced to this:

■ For an eight-bit A-D with a full-scale input

SIGNALS



Oscilloscope trace of a 50Hz sine wave after conversion to digital and back to analogue.

voltage of 5V, the input must not change more than 5/512V(=9,9998V) in 100μs. or 98V/second.

- The maximum rate of change of a sine wave occurs when the voltage passes through zero — figure 1. In the case of a 5V full-scale sine wave,

Frequency = rate of change = $(2\pi \times 5)$

Hence,

Frequency = 98/31.4 = approximately 3.1Hz.

For many applications the ADC-0809 chip will be completely satisfactory, for example:

- Test voltage measurement.
- Digitiser tablet where position is found from pressure on a surface.
- Temperature control in a greenhouse or for central-heating purposes.
- Wind direction, rainfall, humidity, and other meteorological data.
- Measurement of the position of machinery, perhaps a drilling jig.

The Original Microsystems board is unlikely to be successful in applications such as:

- Process control where there is a possibility of positive feedback.
- Speech analysis.
- Physiological data capture such as heart rhythms, electrical changes in the muscles and nervous reflexes.

Despite the calculations, I am uncertain whether or not the Original Microsystem board will be useful for the scanning camera I intend to build for a forthcoming article. A 50Hz sine wave was analysed using the Original Microsystems converters and turned back into an analogue signal using the D-A converter on the board. It gave reasonably accurate representation of the original and I shall have to do more work to see just what jobs can be done using this board.

The second A-D board I want to describe in this article is made by Sagus for I/O Systems Limited. It costs £135 and is intended specifically for the Nascom microcomputer. The 8in.-by-8in. board plugs directly into the Nasbus and is made of glass fibre with printed-circuit wiring on both sides and plated-through connections. A silk-screen print is used on one side to identify each component and the board will be completed with a solder-resist mask. The edge connectors are gold-plated.

There is a PI/O chip on the board connected through buffers to the Nasbus address and data lines. None of the connections to the Nasbus imposes more than one LS TTL load to the Nasbus lines.

There is a generous prototyping area in one corner of the board to which all the Nasbus voltage rails are bought, with provision for decoupling capacitors close to any integrated circuits mounted in the prototype area. Eight miniature jack sockets are provided on the outer edge of the A-D board for the eight analogue inputs and the input lines can be broken close to each jack socket so that the analogue signal can be routed through operational amplifiers mounted in the prototype area to condition the incoming signal before it is passed to the analogue multiplexer.

The multiplexer chip selects one of the eight analogue channels and puts the same analogue voltage on the output from the chip. The chip used by Sagus is made by Harris and has integral protection against excessive input voltages. It can handle transient overloads of several hundred volts.

(continued on page 55)

```
                                0606
                                0606
0058 :                          0606
0059 :                          0606
0060 :                          0606
0061 :                          0606
0062 :                          0606
0063 :  DECIMAL TO BCD INPUT    0606
0064 :                          0606
0065 DECIN  PHP                 0606 08
0066        PHA                 0607 48
0067        TXA                 0608 8A
0068        PHA                 0609 48
0069        TYA                 060A 98
0070        PHA                 060B 48
0071        JSR DIGIT           060C 20 2B 06
0072        CMP £$0D            060F C9 0D
0073        BEQ DN2             0611 F0 11
0074        ASL @               0613 0A
0075        ASL @               0614 0A
0076        ASL @               0615 0A
0077        ASL @               0616 0A
0078        STA SD              0617 85 80
0079        JSR DIGIT           0619 20 2B 06
0080        CMP £$0D            061C C9 0D
0081        BEQ DN2             061E F0 04
0082        ORA SD              0620 05 80
0083        STA SD              0622 85 80
0084 DN2    PLA                 0624 68
0085        TAY                 0625 A8
0086        PLA                 0626 68
0087        TAX                 0627 AA
0088        PLA                 0628 68
0089        PLP                 0629 28
0090        RTS                 062A 60
0091 DIGIT  JSR $FDFA           062B 20 FA FD
0092        LDA ICHAR           062E A5 01
0093        CMP £$0D            0630 C9 0D
0094        BEQ DN1             0632 F0 0F
0095        CMP £$30            0634 C9 30
0096        BCC DIGIT           0636 90 F3
0097        CMP £$3A            0638 C9 3A
0098        BCS DIGIT           063A B0 EF
0099        JSR OPCHR           063C 20 75 FE
0100        LDA ICHAR           063F A5 01
0101        AND £$0F            0641 29 0F
0102 DN1    RTS                 0643 60
0103 :                          0644
0104 :                          0644
0105 :                          0644
0106 :                          0644
0107 :                          0644
0108 :                          0644
0109 :                          0644
0110 :                          0644
0111 :                          0644
0112 :                          0644
0113 :                          0644
0114 :                          0644
0115 :                          0644
0116 :                          0644
0117 :                          0644
0118 :                          0644
0119 :                          0644
0120 :                          0644
```

(listing continued on page 55)

AT LAST!

THE COMPLETE SINCLAIR ZX 81 BASIC COURSE

At last, a comprehensive text for your Sinclair ZX 81! The complete BASIC Course is a manual which will immediately become an indispensible work of reference for all your ZX 81 programming.

Whether you have never done any programming or whether you are an experienced microcomputer user, the Complete BASIC Course will provide itself to you as an invaluable aid.

The Complete BASIC Course is designed to teach you to write and develop BASIC programs for the Sinclair ZX 81 – no other books or aids are necessary. All is revealed in our easy step-by-step guide with programs and "test yourself" exercises all the way through.

As you become more proficient with computing, the Complete BASIC Course will continue to be an essential guide, giving you finger tip references, numerous advanced programming techniques and memory saving devices specifically for the Sinclair ZX 81.

HOW TO WRITE PROGRAMS:

Even if the idea of writing programs is completely mystifying to you, the Complete BASIC Course will show you just how easy it is. In no time you will be able to write and enjoy complex programs for whatever use you desire.

Using the proven "TOP-DOWN" approach, the Complete BASIC Course will show you systematic and simple ways to write programs. Even experienced programmers will benefit from this Course, making programs easier to write and less prone to error!

NUMEROUS EXAMPLES:

Every concept, every function is fully described by simple programs that you can enter on your Sinclair ZX 81 in minutes.

The Complete BASIC Course contains over 100 programs and examples! These programs illustrate the use and possibilities of the Sinclair ZX 81:

- Home use
- Financial analysis and planning
- Educational applications
- Games
- Mathematical applications
- Displays of 'Artificial Intelligence'

EVERY FUNCTION COVERED:

No matter what your application, what your confusion about any function, you will find it covered in the Complete BASIC Course.

A full and detailed discussion is included of even traditionally taboo topics such as USR, PEEK and POKE.

A handy alphabetical summary section lists all functions, and provides a short description and example programs of all topics.

A PERMANENT WORK OF REFERENCE:

The Complete BASIC Course is an excellent reference work for experienced programmers (including tips on using special techniques) as well as a comprehensive step-by-step guide for complete beginners.

The Complete BASIC Course has over 240 pages filled with information in an attractive durable ring binder – this is a lay-flat work of reference that deserves a place next to every Sinclair ZX 81 microcomputer.

OTHER TITLES AVAILABLE:

Melbourne House is the world's leading publisher of books and software for the Sinclair ZX 81.

The following titles are also available if you wish to expand your horizons:

BASIC Course Programs on Cassette -

All major programs in the BASIC Course are available pre-recorded in this set of cassettes. This is a valuable adjunct to the Course, saving you time and effort.

Not Only 30 Programs for the Sinclair ZX 81: 1K -

Not only over 30 programs, from arcade games to the final challenging Draughts playing program, which all fit into the unexpanded 1K Sinclair ZX 81 but also notes on how these programs were written and special tips! Great value!

Machine Language Programming Made Simple for the Sinclair -

A complete beginner's guide to the computer's own language – Z80 machine language. Machine language programs enable you to save on memory and typically give you programs than run 10-30 times faster than BASIC programs.

Understanding Your ZX 81 ROM -

A brilliant guide for more experienced programmers by Dr. Ian Logan, this book illustrates the Sinclair's own operating system and how you can use it. Includes special section on how to use machine code routines in your BASIC p+rograms.

Order Form:

Orders to Melbourne House Publishers
131 Trafalgar Road, Greenwich London SE10

(Correspondence to
Glebe Cottage, Station Road, Cheddington, Leighton Buzzard, BEDS LU7 7NA)

NAME:.....

ADDRESS:.....

.....

.....Postcode.....

The Complete Sinclair ZX 81 BASIC Course	@ £17.50	
Basic Course Programs on Cassette	@ £ 2.50	
Not Only 30 Programs/Sinclair ZX 81:1K	@ £ 6.95	
Machine Language Programming Made Simple	@ £ 8.95	
Understanding Your ZX 81 ROM	@ £ 8.95	
Postage and Packing		£ 0.80
Remittance enclosed		£

(listing continued from page 53)

```
0121 ;
0122 ;
0123 ;
0124 ;
0125 ;  SET CLOCK TIME
0126 ;
0127 TIMES  BYT 'S,'e,'t          0644 53 65 74
0128        BYT ' ,'T,'i          0647 20 54 69
0129        BYT 'm,'e,$00         064A 6D 65 00
0130        BYT $00               064D 00
0131        BYT 'W,'e,'e          064E 57 65 65
0132        BYT 'k,$00,'D         0651 6B 00 44
0133        BYT 'a,'y,$00         0654 61 79 00
0134        BYT 'H,'o,'u          0657 48 6F 75
0135        BYT 'r,'s,$00         065A 72 73 00
0136        BYT 'M,'i,'n          065D 4D 69 6E
0137        BYT 'u,'t,'e          0660 75 74 65
0138        BYT 's,$00,'S         0663 73 00 53
0139        BYT 'e,'c,'o          0666 65 63 6F
0140        BYT 'n,'d,'s          0669 6E 64 73
0141        BYT $01               066C 01
0142 ;                            066D
0143 ;                            066D
0144 ;  DISPLAY TIME FRAME        066D
0145 ;                            066D
0146 DTIM   PHP                   066D 08
0147        PHA                   066E 48
0148        TXA                   066F 8A
0149        PHA                   0670 48
0150        TYA                   0671 98
0151        PHA                   0672 48
0152        LDX NULL              0673 AE 03 06
0153        LDA NULL              0676 AD 03 06
0154        STA ZP1               0679 85 7F
0155 SM2    TAY                   067B A8
0156 SM1    LDA TIMES,X           067C BD 44 06
0157        CMP NULL              067F CD 03 06
0158        BEQ STMX              0682 F0 12
0159        CMP £$01              0684 C9 01
0160        BEQ STMZ              0686 F0 07
0161        STA SCTOP,Y           0688 99 00 02
0162        INY                   068B C8
0163        INX                   068C E8
0164        BNE SM1               068D D0 ED
0165 STMZ   PLA                   068F 68
0166        TAY                   0690 A8
0167        PLA                   0691 68
0168        TAX                   0692 AA
0169        PLA                   0693 68
0170        PLP                   0694 28
0171        RTS                   0695 60
0172 STMX   LDA £$20              0696 A9 20
0173        CLC                   0698 18
0174        ADC ZP1               0699 65 7F
0175        STA ZP1               069B 85 7F
0176        INX                   069D E8
0177        JMP SM2               069E 4C 7B 06
0178 ;                            06A1
0179 ;                            06A1
0180 ;                            06A1
0181 ;                            06A1
0182 ;                            06A1
0183 ;                            06A1
0184 ;                            06A1
0185 ;                            06A1
0186 ;                            06A1
0187 ;                            06A1
0188 ;                            06A1
0189 ;                            06A1
0190 ;                            06A1
0191 ;                            06A1
0192 ;                            06A1
0193 ;                            06EE
0250 ;                            06EE
0251 ;                            06EE
0252 ;                            06EE
0253 ;                            06EE
0254 ;                            06EE
0255 ;                            06EE
0256 ;  TIME SET                  06EE
0257 ;                            06EE
0258 TIME   JSR CLS               06EE 20 D6 06
0259        JSR DTIM              06F1 20 6D 06
0260        LDX £00               06F4 A2 00
0261        LDA £$40              06F6 A9 40
0262        STA ICURS             06F8 85 0A
0263        LDA £$02              06FA A9 02
0264        STA ICURSH            06FC 85 0B
0265 TE1    LDY £$0A              06FE A0 0A
0266        STY VDUIND            0700 84 03
0267        LDA £$5F              0702 A9 5F
0268        STA (ICURS),Y         0704 91 0A
0269 TE2    JSR DECIN             0706 20 06 06
0270        LDA ICHAR             0709 A5 01
0271        CMP CR                070B CD 04 06
0272        BEQ DT2               070E F0 0E
0273        JSR $FDFA             0710 20 FA FD
0274        LDA ICHAR             0713 A5 01
0275        CMP CR                0715 CD 04 06
0276        BNE TE3               0718 D0 1A
0277        LDA SD                071A A5 80
0278        STA WK,X              071C 95 F8
0279 DT2    CLC                   071E 18
0280        LDA £$20              071F A9 20
0281        INY                   0721 C8
0282        INY                   0722 C8
0283        STA (ICURS),Y         0723 91 0A
0284        ADC ICURS             0725 65 0A
0285        STA ICURS             0727 85 0A
0286        INX                   0729 E8
0287        CPX £$05              072A E0 05
0288        BNE TE1               072C D0 D0
0289        JSR CLS               072E 20 D6 06
0290        JMP ST1               0731 4C A4 06
0291 TE3    LDY £$0A              0734 A0 0A
0292        LDA £$20              0736 A9 20
0293 TE4    STA (ICURS),Y         0738 91 0A
0294        INY                   073A C8
0295        CPY £$1F              073B C0 1F
0296        BNE TE4               073D D0 F9
0297        JMP TE1               073F 4C FE 06
```

(continued from page 53)

After leaving the multiplexer, the analogue signal is then taken to a sample-and-hold circuit, and this is the crucial distinction between the board made by Original Microsystems and the one manufactured by Sagus.

The sample-and-hold circuit looks at the incoming analogue signal for about 15μs. and then holds that value while the analogue-to-digital conversion is performed. The difference between the two boards essentially is then that the amplitude of the incoming signal should not change substantially for either the whole period of the A-D conversion, 100 to 150μs. in the case of the Original Microsystems board, or for the period necessary for the sample to be taken and frozen, 15μs. in the case of the Sagus board.

In fact, the board also has an extremely fast A-D converter and the whole conversion process, including the sample and hold, takes 30μs. The designer says that the board will accurately resolve speech and other analogue signals up to a frequency of about 15kHz. The rate at which you manage to make the board work in your system will depend on how clever you are at moving each value from the Original Microsystems board and into memory.

The Sagus board dedicated to the Nascom, is more sophisticated than the Original Microsystems version and is selling well to industrial users. The Original Microsystems board seems a little overpriced in comparison but should prove a compact and useful analogue interface for applications which fall within its limits — it is a worthwhile piece of equipment to have as part of the real-time system I am building.

The majority of the software set out in the listing is concerned with the dialogue between the Tangerine Microtan computer and the computer user. For example, the subroutine "Display Time Frame" displays the information in the Times table in the top half of the Microtan VDU screen.

Line 152 — LDX NULL — is an instructin to load X with zero and the machine code at location 673 to 675 will need altering by anyone who is not using a two-pass assembler and who cannot equate the label null to a zero byte. The label SCTOP in line 161 refers to the top left-hand memory location of the Microtan VDU memory and this should be altered to suit other systems.

The time-set program first clears the screen using the subroutine CLS and then displays the frame of information with the call to the subroutine in line 259. The labels ICURS, ICURSH, VDUIND and ICHAR refer to zero-page locations used by the Microtan Tanbug monitor and it may be difficult to make a straightforward translation between this program and another system. Most of the rest of the instructions in this module are concerned with error trapping.

Non-numeric characters are rejected by lines 95-98 in DECIN, two figures are required for each input, e.g., 06 for day, and any third figure other than a carriage return blanks the line and starts the input routine again.

Pressing the return key before or during an entry skips to the next line and leaves the previous variable, e.g., hours, unaltered. It is possible to set the seconds count only by pressing the return key until a cursor or underline character appears opposite the seconds line.

The time-set module is difficult to crash and is a good example of a simple and comparatively foolproof input to the computer. When the time has been set, the program jumps to ST1 — line 290 and this instruction should be changed to suit your own program until I present the definitive start to Cogent and the source-program entry routines next month. ■

SOFTWARE BACKUP

FOR THESE CASIO WORLD BEATERS

World's Most Powerful BASIC Pocket Computer

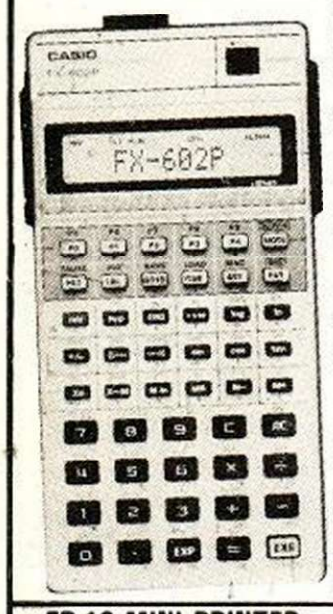
FX-702P
RRP
£134.95

ONLY
£119.95

Plus FREE MiCROL Professional Programming Pack* (RRP £9.95).

Flattens the Sharp PC1211

Alpha/numeric dot matrix scrolling LCD. Variable input from 1680 steps, 26 memories, to 80 steps, 226 memories, all retained when switched off. Up to 10 programs. Subroutines; 10 levels. FOR: NEXT looping; 8 levels. Debugging and Editing. 55 built-in functions, including Regression and Correlation, all usable in programs. Program/Data storage on cassette via optional FA-2 adaptor (£19.95). Auto Power Off. 17 x 165 x 82mm. 176g.



World's Fastest Programmable? FX-602P

- LCD alpha/numeric (dot matrix) scrolling display.
- Variable input from 32 program steps with 88 memories, to 512 steps with 22 memories.
- Memory and program retention when switched off.
- Up to 10 pairs unconditional jumps (GOTO).
- Conditional jumps and count jumps. Indirect addressing. Manual jump.
- Up to 9 subroutines, up to 9 levels.
- 50 scientific functions, all usable in programs.
- PAM (Algebraic) with 33 brackets at 11 levels.
- Program and data storage on cassette tape using optional FA-2 remote control adaptor, £19.95.
- Compatible with the FX-501P and FX-502P.
- 9.6 x 71 x 141.2mm. 100g.

ONLY £74.95 (RRP £84.95)
Plus FREE MiCROL Professional Programming Pack* (RRP £9.95)

FP-10 MINI PRINTER For FX-702P, FX-602P, FX-502P, FX-501P, **Available soon.** Price and delivery on application

CASIO FX-702P SOFTWARE

Produced by **MiCROL** exclusively for Tempus
10% discount on software, if you purchase your hardware from us.

MICROL 702 USER SUPPORT

Professional Programming Pack. Get the best from your FX-702P with: PROFESSIONAL PROGRAMMING — practical 702 programming from the ground up **plus** 702 REFERENCE MANUAL — definitive guide to every 702 program command — INVALUABLE! **MiCROL 702 PPP.** Price **£9.95**

MiCROL PROCOS for PROFESSIONAL USERS

Now you can create powerful, reliable programs in just minutes, even if you have never programmed a computer before!

MiCROL PROCOS is an advanced integrated operating system that cuts programming time by 80-90% in most applications areas, saving many hours of valuable time. PROCOS A and PROCOS B are supplied together on a ready-to-run cassette, with a fully detailed User Manual offering features to suit every application. PROCOS A is ideal for complex multi-variable calculations, while PROCOS B provides many of the features of a 'Visicalc' type modelling system — answers 'what if' questions and analyses trends. Both systems feature easy-to-use commands and support FP-10 print options. Brochure on request.
Available late November **MiCROL PROCOS (A + B)** Price **£24.95**

MiCROL 702 Basic: Plus. Add the power of up to 20 new commands to your programs! Custom-made to ease advanced programming — features include: String — number conversions; single-shot, await, timed KEY with user-controlled return values; programmable RAN // generator; DATA-PACKING — up to 2000 single digit, single name variables; INTEGRATED DISPLAY COMMANDS — display data and test with extra-low memory overheads. Modular design uses minimum memory; easy to customise. Full-detail User Manual plus Program List for direct entry.
Available December, 1981. **MiCROL 702 B:P.** Price **£14.95**

SHORT FORM CATALOGUE of latest calculators, keyboards and watches available on request. 14p stamp appreciated

***Only on request, at time of ordering.** RRP of 702P/602P versions, **£9.95.**

Price includes VAT, P&P. Delivery normally by return of post.

Orders received by Dec 18th should be delivered in time for Christmas

Send cheques, PO, or 'phone your Access or B'card number to:

TEMPUS Dept YC1/FREEPOST
164-167 East Road, Cambridge
CB1 1DB Tel: 0223 312866
Vat. no. 327 6665 32

FOR THE 16K OR ABOVE

ZX81 PET

TRS 80 LEVEL II AND VIDEO GENIE

RUBIK CUBE SOLVER (16K)

Rubik's cube completely solved from any starting position.

RUBIK CUBE SIMULATOR (8K)

Also available for the 8K new monitor UK101 this easy to use program simulates all the possible movements of the cube. By storing all your moves and even allowing you to run backwards to a previous position, the simulator makes the formulation of your own solution possible.

OFFER EXTENDED UNTIL FEB 28

Rubic Cube solver + instruction booklet £6.00 **£4.50**
Rubic Cube simulator + instruction booklet £5.00 **£4.00**

SPECIAL OFFER!

The Solver + Simulator + Booklet £7.00 **£5.50**

MANY MORE PROGRAMS AVAILABLE

If you own a ZX81 with 16K, TRS 80 Level II Video Genie, PET or UK 101, send 95p for full catalogue and free listing. This will be returned against first order. (Please state machine).

All the above prices include p&p and V.A.T.

Available from:
Oasis Software,
Lower North Street,
Cheddar, Somerset.

OASIS SOFTWARE

---

reprints

If you are interested in a particular article/special feature or advertisement in this journal

HAVE A GOOD LOOK AT OUR REPRINT SERVICE!

We offer an excellent, reasonably priced service working to your own specifications to produce a valuable and prestigeous addition to your promotional material. (Minimum order 250 copies). Telephone Martin Bloomfield on 01-661 3036 or complete and return the form below.

To: Martin Bloomfield, Your Computer, Reprint Department, Quadrant House, Sutton, Surrey SM2 5AS

I am interested in .....copies of article/advert.

headed .....featured in this

journal on pages ....., issue dated .....

Please send me full details of your reprint service by return of post.

Name .....

Company .....

Address .....

.....Tel. No .....

FINGERTIPS

Fingertips is our regular calculator column covering calculator news, programming hints and examples of unusual applications. The column is written and compiled by calculator enthusiast David Pringle who is glad to hear of any of your ideas. *Your Computer* pays £6 for each of your contributions published.

AS PROMISED SEVERAL moons ago, I am still aching to tell you about some extraordinary programming manoeuvres on the HP-41C. Before jumping in head first, you need a feeling for the memory layout of these machines.

The basic addressable unit of memory is the byte — a series of eight binary digits which, for convenience, may be thought of as two four-digit nybbles. In data memory numbers are stored as binary-coded decimal in groups of seven bytes, or registers.

Any base-10 digit — value 0 to 9 — may be expressed in terms of a four-bit binary nybble. Thus 14 nybbles can define a 10-digit number, its two-digit exponent and the sign of each. You might say, though, that we are wasting a bit of capacity here, as we never need a nybble of value greater than 9_{10} — that is, 1001_2 — in data memory. We do, in fact, have the capacity to store hexadecimal code or base 2^4 if so desired.

This property is fully utilised in program memory where each stored byte has a specific function or part of a function assigned to it. Program lines must then be thought of as single bytes, or combinations of bytes, as opposed to pieces of a register.

We will eventually see how some bytes are related to certain functions and how to program non-standard bytes — those combinations of digits not used for standard functions listed by catalogue 3.

This method, called synthetic programming, may be used to generate new characters via the display, increase the available memory and much else.

It should be immediately apparent that the stored code interpreted from data memory is translated differently to code in program memory, or, say, the alpha-numeric register. There are, then, three levels of code in the calculator.

- **User Code:** That displayed or entered on keyboard, etc.
- **Memory Code:** Series of bits of digital information, combined as bytes and registers.
- **Machine Code:** Language of the processing unit.

Translation from memory code to user code depends on what type of memory the processor has assigned to that code. To appreciate the importance of this point, perform the following:

- Insert a single-density memory module into your calculator.
- Execute a Master Clear — that is, turn off the calculator, press the button and, keeping the button still depressed, turn the calculator back on. "Memory lost" will appear on the display, so only do this if you have saved all of your valuable programs.
- Set size 063.
- Switch to program mode. Key in the lines: 01 12345
  02 STO IND 17
  03 RDN
- Switch the calculator off and remove the memory module.
- Wait one minute, replace module and turn on.
- Press RTN.
- Enter 1,594354305 EE53.
- Press SST and switch alpha on.

Where did the first character, not mentioned in the Hewlett-Packard handbook, appear from? What about that piece of *Your Computer* propaganda — YCTOPS — meaning "*Your Computer* is Tops"? Well, all the rigmarole of removing the memory module and then replacing it after its contents were lost permit us to succeed in two things.

The number entered after turning the calculator on again was interpreted as a programmable alpha-numeric string. Thus YCTOPS and 1.594354305 EE53 are stored in memory as identical binary code. The stored program, if you are to look at it, is now a one-liner called STO M.

This is, in fact, a non-standard combination of bytes IND 17 and RDN interpreted as one line in that order. You will not have seen the M "status register" as such in normal programming. Figure 1 is a diagram to show how the memory of the 41-C appears in schematic form if one module is attached.

Register 0, R00, is at the interface of data and program memory — which are, you will note, labelled in opposite directions. Its absolute address in memory is held in a register so that the processor knows exactly where the division lies.

The absolute address may be defined by four nybbles — one for the byte number and the other three for the register number. The current size is simply the number of data registers between the top of the memory and R00.

With nothing at all keyed into program memory, already three bytes are accounted for. The last three bytes of the first program register contain the permanent . End . which is a permanent barrier to the address pointer. It stores the absolute position of the program byte currently being processed and forbids any entry into the lower parts of the memory system.

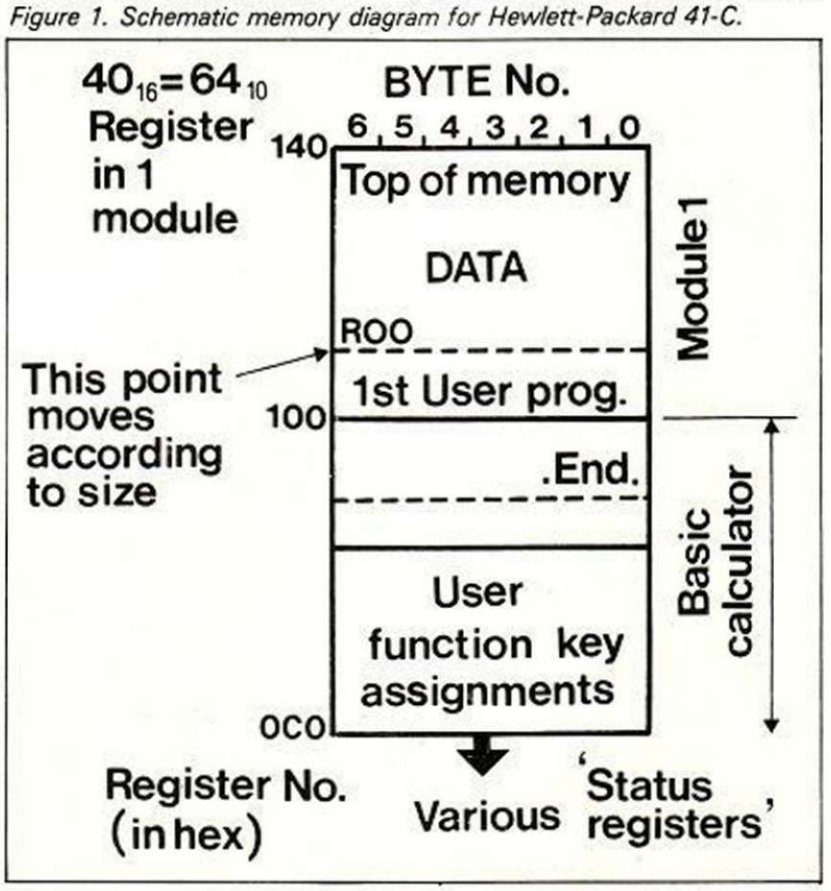
As we add more program lines, so the . End . descends automatically to the last three bytes of the lowest filled program register. The lowest part of memory shown contains the information on which keys are assigned to which functions in user mode.

The division into registers is not really vital for program memory purposes because, as I have already said, the program line in interpreted as a byte or series of bytes. I suppose it is really multi-byte lines which give the HP-41C its very advanced capabilities.

Remember how I said that every byte stored in a program had a specific function. A single-byte machine would then only have a maximum of 2^8-1 = 255 different programmable lines. That is acceptable if your calculator can only hold 30 lines. What of an HP or TI with more than 2,000?

If your machine has 200 data memories you would need 400 bytes alone to STO (re) and REC (all) them directly. The obvious solution is to allow a combination of bytes — the HP-41C can accept up to a 16-byte series — allowing a semi-infinite number of possibilities.

Figure 1. Schematic memory diagram for Hewlett-Packard 41-C.



JARGON

■ Hexadecimal

Hexadecimal — or hex to calculator buffs — arithmetic is base 16 as opposed to the base 10 of decimal arithmetic. In other words, the maximum value for a hexadecimal digit is 15_{10}. So that we can express all hexadecimal digits by single characters the standard notation used is $A_{16}-F_{16} = 10_{10}-15_{10}$. So $1FF_{16} = 511_{10}$. Hexadecimal is popular because it is the briefest way of expressing both nybbles and bytes of binary information. For example, the nybble 1011_2 is exactly equal to B_{16}. Hence the hexadecimal addressing system shown in Figure 1.

For instance, the commands GTO 00 → 14 are all two-byte functions. The first byte determines the label number 00 → 14 to which the pointer is to jump. The second byte holds the information containing the direction of the jump and exactly the total number of whole registers and remaining bytes which need to be jumped.

When first written, the second byte is full of zeros — 0000 0000 — and it is only after the program has searched for the requisite label the first time that the information is written for future use. Hence, the first jump takes considerably longer than the rest.

If the first digit of this second byte is reserved for direction information, then the maximum number of steps we can record by this method are 1111_2 registers + 111_2 bytes — that is, 16_{10} registers.

For labels greater than 014 the processor forces us to use a three-byte GTO command. The extra byte lets us store as large a jump as we might wish. So if you want to save bytes and time, keep labels less than 14 and the relevant Goto within 16 registers. If, further away, the program performs a big search every loop and if your LBL and GTO must be separated by more than 16 registers or 128 bytes, it will be quicker to use a Label greater than 014.

So our poor, overworked translator has to be told not only with what kind of memory it is dealing but also, in program memory, the order of the individual bytes. In other words, the second byte of the GTO command would be interpreted entirely differently if it was on its own as a program line.

Hence the translator, when reading lines, must determine whether it is a single byte — e.g., STO 01 — or multi-byte line. This is why the BST or back-step operation often consumes a good deal of time. The pointer has to jump to the top of the

(continued on next page)

(continued from previous page)

current program file and work its way through to the previous line as it has no way of knowing whether the previous byte is part of a single or multi-byte line.

The exciting part of all this — editing our own variations of multi-byte lines and seeing what happens when we try to print, display or make a noise from them — will have to wait until next month. I shall also let you into the secret of how you can obtain all the information you ever wanted to know about synthetic programming but were afraid to ask. Until then consider:

- What separates an End statement or program Label from other pieces of program?
- Why an . End . might occupy three bytes.
- What would happen if you placed the permanent . End . in one of the memory modules and then removed the module.

Let's do it just for fun: Insert a single-density memory module and perform a Master Clear. Execute size 000 which places . End . in the module. Key in:
ASN "X< >", SHIFT, +, ASN "Σ+", Σ+

Switch off the machine and remove the memory module; wait two minutes and then replace the module. Switch on again and enter program mode. We now see 00 REG 126. Press SST once and wait a few seconds. Where are we?

Finally, two readers' programs. The first from Chris Histed of Chiselhurst, Kent.

Having just bought a Casio FX-3600P — essentially the same as a FX-3500P — I decided to write a quick game for it and chose to implement Hi-Lo, he writes. My version of this well-known game fits into the 38 steps of the calculator with a few steps remaining in memory, and uses the M memory and K memories 1 to 3.

To enter the program, enter mode 0 or programming mode, and select program 1 — P1. Now, enter the steps as shown in the listing exactly. Then still in mode 0 enter the steps for program 2. The first step is to press the dot key.

Once you have finished entering the program, you will still be in mode 0, so press mode dot, to enter run mode. Now, press P1 to run program one, and if you have pressed all the right keys, the display will go blank for about a quarter of a second and then will return, having set all the registers that program two will need, including the random number. Press P2 to run program two.

The display will produce a zero and an enter number prompt. Now you must enter your guess at the random number, between 001 and 999. Press the run key to enter your guess, and a random number will be displayed. If this is positive, your guess was too high, and if negative, your guess was too low. If you guess the number correctly, a zero will be displayed.

```
Program 1:
  -0.0001        Put this value
  inv            into M register.
  Min
  inv            Create random number.
  Ran#
  Kin 1          ...and put it into K 1.
  C              Clear display.
  Kin 3          put zero into K 3.

Program 2:
  .              Enter your number
  Ent            as a fraction
  Kin 2          Save this value in K 2.
  C              Clear Display
  (
  Kout 2         Produce a random
  -              number which is
  Kout 1         negative if K2 is less than K1
  )              positive if K2>K1 , and zero
  x              if you guess correctly.
  inv
  Ran#
  =              Display this number.
  inv
  Hlt
  inv
  X>0            Is your number too big, if so then
  invx           return to start.
  x<Mr           is your number too low, if so return.
  999            Display 999 to tell you that you have
  inv            guessed right.
  hlt
  Kout 3         Display the number of moves i took you.
  inv
  hlt            The end folks!!!
```

Hi-Lo program for Casio FX-3600P.

After this number has appeared, press enter again to continue the program. If your guess was too low or high, another number input will be prompted, but if you had the right answer, a 999 will be displayed. Press enter again and the number of moves you took to guess it will be displayed.

Finally, a program suitable for the Sinclair Enterprise by Neil Talbot of Oxford. In my numerical version of the well-known video game Space Invaders the calculator display shows the number of invaders in each column, and how many lives you have left he writes. For example:

3210342.2
Number of invaders per column — Lives left

There are two invaders in the units column, four in the tens column, three in the hundreds column and so on. To shoot an invader in the units column, enter 1. For the tens column enter 10, for the hundreds column enter 100, and so on up to 1,000,000 for the millions or leftmost column.

```
00   HALT
01   STØ
02    1
03   RCL
04    Ø
05    ×
06    ⁿ
07    ∜
08    =
09   STØ
10    6
11    +
12   RCL
13    4
14    -
15   RCL
16    4
17    -
18   RCL
19    6
20   x<->y
21    -
22   STØ
23    Ø
24   ./EE
25    Ø
26    8
27    =
28   GIN
29    6
30    Ø
31    -
32   ./EE
33    1
34    5
35    =
36   GIN
37    7
38    7
39    -
40    .
41    Ø
42    6
43    =
44   GIN
45    6
46    8
47   RCL
48    1
49   +/-
50    M+
51    3
52    1
53    5
54    Ø
55    M+
56    5
57   GOTO
58    7
59    7
60    .
61    1
62   +/-
63    M+
64    3
65   GOTO
66    7
67    7
68    1
69    1
70    1
71    1
72    1
73    1
74    1
75    M+
76    3
77   RCL
78    3
79
```

Pre-executions:
Put 0 in store 5.
Put 1 × 10^9 (1/.EE/.RR/9) in store 4
Put 3333333.3 in store 3
Put any number between 0.3 and 1 in store 0.
Then:
GOTO/0/1/0/Run/Initial positions

Execution
Shoot — enter 1,10,100, etc.
Invaders displayed

There are four possible results: you hit an invader which is eliminated; you miss; you are shot by the invaders — you lose one life; the invaders advance and a new line is added.

The game ends when you run out of lives — the decimal place will disappear — or when the invaders land — a number five appears in one of the columns of invaders.

To find your score reclaim store 5. A score of more than 10,000 is excellent. If you destroy all the invaders, you are given a bonus life and a new batch to destroy. Press the following keys before continuing:
+/3/3/3/3/3/3/3/.EE/1/=/STO/3/

RESPONSE FRAME

Do you have a problem? Your manual is incomprehensible or you just cannot get the hang of that programming trick you tried — whatever it is, Tim Hartnell will do his best to answer your queries. Please include only one question per letter and mark them "Response Frame".

SINCLAIR GAMES

■As a 14-year-old, the prospect of playing games on my ZX-81, especially Space Invaders, interests me greatly. I have seen many advertisements of this game for my 1K of RAM, but do not know which one to buy. I would, of course, wish to buy the most realistic one, preferably without a flicker. I would prefer to buy the program on cassette. Could you please advise me on which one I should buy?

Ian Harper,
Hemel Hempstead, Hertfordshire.

IT IS DIFFICULT to pick out a single Space Invader program and say that is the best. Partly because we have not seen all of them in action, and partly because opinions about the best are just that — opinions. However, perhaps a useful rule to follow when buying an important program like this is not to buy the cheapest. Read advertisements in detail, and if you are near one of the suppliers, ring to see if you can have a demonstration. All ZX-81 Space Invader games are flicker-free. You will, of course, obtain a better game if you upgrade your memory, as the larger memory Space Invader programs have more flexibility.

UK 101 GRAPHICS

■Please could you give me some information on how to use UK 101 graphics? All I manage is to call characters into the middle of the screen using Tab statements. This is very time-consuming and I am sure there must be an easier way. The brief Compukit manual hints at CHR character slots, but I do not know how to use them.

Andrew Ethell,
Coalville, Leicestershire.

POKING DIRECT into the display file seems the simplest way. The manual will give you the start address of the display file.

WHY NO GO?

■As a complete novice in the micro world, but eagerly awaiting my Vic-20, I am curious about several things. First, are floppy tapes useful? They appear to be half-way between cassette and disc but I do not know whether I should consider such a device for my Vic-20. Secondly, is anyone writing programs for Go instead of Chess?

J D Collins,
South Woodford.

FLOPPY TAPES are a good and successful product, but are only made for certain computers, including the TRS-80. You require a special cassette recorder for the Vic. Draughts is relatively easy to program, since it is nearly all tactics, and so can be reduced to a series of algorithms relatively easily. Chess is a combination of strategy and tactics, and a program which compensates for the lack of strategy by painstakingly following "tactic trees" can be written, although nowhere as easily as the draughts programs. Go is a very subtle game and nearly all strategy, and that is why Go will be the last program for which a computer will be able to provide a grandmaster level of play.

ZX-80 TO ZX-81

■I would like to know if it is possible to change ZX-80 programs to work on a ZX-81. If so, could you please explain how.

Martin Banks,
Bolton, Lancashire.

MANY PROGRAMS written for the ZX-80 will run almost as listed on an ZX-81, but will generally consume far more memory. That is, a 1K ZX-80 program will often not fit a 1K ZX-81. You will have to change the way random numbers are generated:

Old ROM	New ROM/ZX-81
LET J = RND(6)	LET J = INT(RND*6) + 1

Omit the moving display from a ZX-80 program completely. Instead of using the line

```
POKE Y*33 + X + 1 + PEEK(16396)
     + PEEK(16397)*256
```

to place a character of your choice at a position of your choice — although this routine works on both the ZX-80 and the ZX-81 — replace it with

```
PRINT AT Y,X;"BYTE"
```

on the ZX-81. Since all the graphics symbols, including inverse graphics, inverse numbers and letters, and even an inverse space, are available directly from the ZX-81 keyboard, you need not use the CHR$(n) they require on the ZX-80. To convert ZX-80 listings to ZX-81, use the following table, in which the old-ROM position is followed by the new ROM:

Shift Q, graphic 5; shift W, graphic 6;
shift E, graphic 1; shift R, graphic 2;
shift T, graphic D; shift A, graphic A;
shift 5, graphic T; shift D, graphic 4;
shift F, graphic 3; shift G, graphic S.

The first address after the word Rem on the old ROM is 16427. The equivalent address, useful for Poking into Rem statements, is 16514. The TS$ function on the old ROM can be replaced with (2 TO). That is,

```
LET A$ = TL$(A$)
```

on the ZX-80 is the same as

```
LET A$ = A$(2 TO)
```

on the ZX-81.

ZX OTHELLO

■I was intrigued by the idea of the Othello program in the October 1981 edition and attempted to put it into my ZX-81 with 16K RAM. Unfortunately, I cannot make it work. The program I have put in tallies exactly with the listing printed in the magazine, except for the obvious printing error at line 810. Can you please let me know what modification is needed to run it on the ZX-81?

D Salle,
Solihull, West Midlands.

UNFORTUNATELY, the program you refer to relies heavily on the way the logic operates on the ZX-80, and this is totally different from the ZX-81. Therefore, the two cannot be exchanged. It would be easier to write an Othello program from scratch rather than try to convert the ZX-80 listing.

YOUR DECISION

■I own a ZX-80 and I am interested in a new machine. I am looking at the Acorn Atom, Vic-20 and Microtan 65. Also, I could expand my ZX-80 with an 8K ROM and 16K RAM. What is your advice?

Michael Walton,
Giggleswick, Settle.

ONLY YOU CAN decide what you should buy next, but our advice is to write to the main suppliers of the machines you are considering buying, asking for detailed information leaflets. Then, when you have gathered enough information, answer the following questions:

- How much is the computer; can I afford it?
- Does it work in a Basic I know?
- Can I program it in Assembler?
- How much memory is there with the standard version? Is it enough for me?
- What will be the main application for the computer. Will this computer do the job satisfactorily?
- Is the machine widely used, and is there a strong users' group? — they help tremendously in making the most of your computer.
- What impression was I given by the speed and helpfulness or otherwise when I made my initial enquiries of the manufacturer? Is the manufacturer likely to be helpful with future problems and/service?

ROM AND RAM

■I have just read cover to cover your journal. I am a little confused: I would dearly like to invest in a microcomputer in the price range of £50 to £150. I would like to use it for the following: business data files and word processing; map co-ordinance — non-graphic; navigation; education; and lastly, to help with the jackpot on the pools. While I can understand RAM/ROM are capacities which need to be taken into consideration, I am a little confused as to what they mean in real terms. For example, I presume I could put the A to Z of London into RAM, and could then call up any street to find my page number and co-ordinate. Could this be done on say a Sinclair ZX-80 or ZX-81, using one cassette? If not, I would like your advice on what could handle such information if any. I would prefer to pay extra for a micro which I would not outgrow in six months or so.

N Smith,
Witham, Essex.

RAM IS THE amount of memory you have on a computer to fill with information as you choose. ROM is the locked-in memory supplied with the machine which gives it the ability to make decisions, process numbers and the like. In general terms, the bigger the ROM and RAM, the more powerful the computer. You would need a machine which handled floppy discs for the A-to-Z map use you mention, and the ZX-81 cannot yet handle discs, although Macronics is, I believe, developing such a system. You would need, I suggest, to spend in the £300-£500 range to buy a computer which would do what you desire. If the map reference use is vital, floppy discs will be required.

VALUE OF VIC

■I own a Sinclair ZX-81, with a 16K RAM pack and a good deal of software. Now I am thinking of selling it and buying a Vic. If I do, I hope I will not have to wait three months for it, as I did with my ZX-81. I am not sure, however, how much I could expect for my machine, and so wonder whether the advantages of a Vic would be worth the extra money. Can you offer any advice?

D Hollis,
Compton, Wolverhampton.

WE HAVE SEEN ZX-81s with 16K packs selling for around £80 to £100 which seems the going second-hand price. Despite this relatively low trade-in price, the greatly added flexibility of the Vic compared with the ZX-81 definitely makes the extra cost worthwhile.

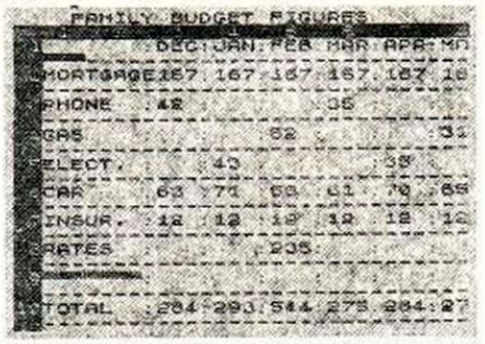
EXTRA MEMORY

■I am thinking of buying either an unexpanded Atom or Microtan 65 and I was wondering which would be better for expansion, if after a while I thought I needed more memory.

Simon Jeff,
Warwick.

THE EASE OF adding memory is, we suggest, not the most important criterion by which to choose a computer. Note that the Atom has on-board Basic while the Microtan has only hexadecimal — although it can be expanded into a Micron. Buying from the manufacturer, you can fit 12K RAM on the Atom, although at least one independent firm is selling a 128K pack which fits within the case. ■

COMPUTACALC ZX



Financial Planning for the ZX81 16K

Ideal for solving "what if" problems at work or home. The screen acts as a window on an "electronic worksheet" consisting of a grid of rows and columns of headings, numbers or formulae.

This powerful piece of software brings the capabilities of the ZX81 into line with much more expensive computers. Computacalc will quickly become the most used program in your library as it takes over from pen, paper and calculator in aiding everyday financial decisions. For further details see Guy Kewney's article in Datalink 30/11/81, send SAE or ring 01-603 6074.

For cassette and full documentation send cheque or P.O. for £7.95 to: **Silicon Tricks, Dept. C3, 2-4 Chichester Rents, Chancery Lane, London WC2.**

Silicon Tricks

ATOM SOFTWARE

SOFTSCREEN (10K RAM) **only £11.40 incl.**

At last a program that overcomes the display limitations of the Atom. Using mode 4 graphics this program allows text and high resolution graphics to be mixed anywhere on the screen — ideal for labelling graphs, etc. Full upper and lower case text, it is even possible to redefine the character shapes. For the first time the Atom can display up to 42 characters per line with 24 lines. Other features include:

- Definable text 'window' area
- Move the cursor to X, Y
- Text in modes 1-4, etc. etc.

INVADERS (12K RAM) **only £8.50 incl.**
A brilliant new version of this game. More features than any other including six skill levels and high scores, 'walking' invaders, sound effects, free from video noise. High resolution graphics and a high speed game.

ALARM CLOCK AND SOUND EFFECTS
(2K RAM each) **only £4.95** for the two
Digital clock keeps time while other programs are running. 'Sound effects' give a range of tone and noise effects without stopping the Atom. Both programs need the 6522 VIA.

COMING SOON: A sophisticated wood processor for the BBC Micro suitable for both models A and B. Further details on request.

WANTED: We pay excellent royalties for any quality programs for the BBC Micro or the Atom. We are especially interested in any good machine code chess programs for the BBC Micro.

MAIL ORDER ONLY

COMPUTER CONCEPTS
16 WAYSIDE
CHIPPERFIELD
HERTS. WD4 9JJ
Tel: (09277) 62955

S. ELECTRONICS ZX81 BUSINESS START UP PROGRAM

- Calculate how to maximise cash flow without overtrading.
- Program on cassette. Comprehensive manual describes how to adapt the program to a wide variety of applications.
- Business game based on the program included on the cassette.
- No memory expansion needed. Runs in the standard ZX81.
- Blank cassette on which to develop your own program included in the pack.

Send cheque/PO for £7 payable to:
S. ELECTRONICS
Box 321, YOUR COMPUTER,
Quadrant House, The Quadrant,
Sutton, Surrey SM2 5AS.

HILDERBAY LTD
PROFESSIONAL SOFTWARE

IF YOU DON'T BELIEVE THAT THE ZX81 + 16K CAN DO REAL WORK . . .

Come and see us at the ZX Microfair
(30 January 1982, Central Hall Westminster, London SW1)

ZX81 + 16K SOFTWARE:
- ✱**PAYROLL** for up to thirty employees. Meets all regulations. £25.
- ✱**STOCK CONTROL** fast, big and versatile. £25.
- ✱**BUDGET** £15
- ✱**CRITICAL PATH ANALYSIS** up to 500 activities. £15
- ✱**VAT+ MORTGAGE+ LOAN** £8
- ✱**PERSONAL BANKING** £15
- ✱**GOLD** an adventure game: try it if you have a week to spare. With another game on the same tape. £8
- ✱**MEMOTECH** 48K memory module for ZX81.
- ✱**RELIABLE 16K RAM** packs — cheaper than Sinclair! phone for price.

More details in our December 1981 advert, or from us

Prices include VAT, postage and packing.
C.O.D. orders £2 extra.

Hilderbay Ltd (YCJ)
8/10 Parkway
Regents Park
London NW1 7AA

Telephone: 01-485 1059 **Telex 22870**

SOFTWARE FILE

Software File gives you the opportunity to have your programs, ideas or discoveries published. We will accept contributions for any personal computer and will group programs for like machines together in the file. Please double-check your listings before sending them. Mark your letter clearly for *Your Computer.* We will pay £6 for each contribution published.

Effortless index

L Basford,
Crewe, Cheshire.

ZX-81

A SUCCESSION OF words or phrases as long as the RAM can accommodate is entered in any order, the program is run and, hey presto — the entries are printed in a strictly alphabetical sequence.

With 16K of RAM it is feasible to index several issues of *Your Computer* or to assemble a personal telephone directory or catalogue in detail a collection of gramophone records.

As printed here the program has been stripped down to its bare essentials to fit the unexpanded ZX-81. In this form, it will accept a maximum of 19 words of 10 characters: this is a convenient number since the result can be displayed down the screen without having to invoke Cont.

Of course, it is not restricted to words of 10 characters: the string length can be adjusted simply by changing the appropriate figure in line 30; but without extra memory one has to opt for either a greater number of shorter words or a smaller number of longer words.

The program is very straightforward and loads easily. It consists of a two-dimensional string array whose contents are inspected in lines 65-75: if any two adjacent entries are out of alphabetical order they are transposed by the subroutine of lines 85-95. A subsequent inspection — lines 105-115 — checks that each entry is by now occupying its proper place in the sequence.

Because it needs to initialise an array, the computer will ask at the outset how many words it is to receive. As soon as it has been given the answer by inputting X, the string-input cursor, L, appears and the entries can then be typed in with each one followed as usual by Newline.

After the final Newline there is a blank-screen interlude — hardly noticeable unless X is large — before the alphabetical list automatically appears on the screen.

```
10  PRINT "NUMBER OF WORDS",
15  INPUT X
20  PRINT X
25  PRINT
30  DIM A$ (X, 10)
35  FOR N = 1 TO X
40  INPUT A$ (N)
45  PRINT A$ (N)
50  NEXT N
55  FAST
60  CLS
65  FOR N = 2 TO X
70  IF A$ (N - 1) > A$ (N) THEN GOSUB 85
75  NEXT N
80  GOTO 105
85  LET Z$ = A$ (N - 1)
90  LET A$ (N - 1) = A$ (N)
95  LET A$ (N) = Z$
100 RETURN
105 FOR N = 2 TO X
110 IF A$ (N - 1)> A$ (N) THEN GOTO 65
115 NEXT N
120 SLOW
125 FOR N = 1 TO X
130 PRINT A$ (N)
135 NEXT N
```

Keyboard changes

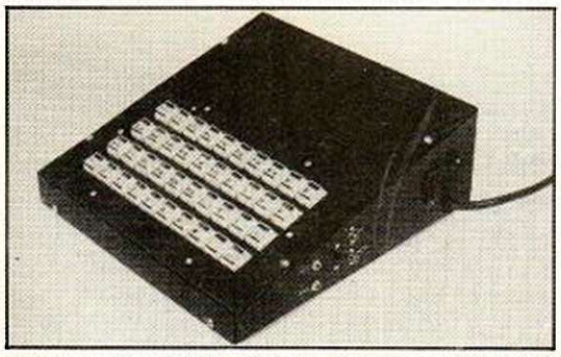
D Butler,
Chelmsford, Essex.

ZX-80

AS A NEWCOMER to computing, I was very impressed with the ZX-80, but less impressed with the way its keyboard had been engineered. I decided to see if it would be possible to fit proper key switches in place of the touch key-pads.

Although there are 40 keys, there were only 13 conductors leading from the keypad circuit to the main computer itself. I found some suitable switches from Maplin Electronic Supplies to do the job. The switch is bought as one item; the key top and Perspex cover are bought as another.

It was obvious from the start that the original case would not accommodate the new keys so I had to think about a new case. If I



was to do that, I might as well design the case to accommodate the plug-in 16K RAM pack and the power supply.

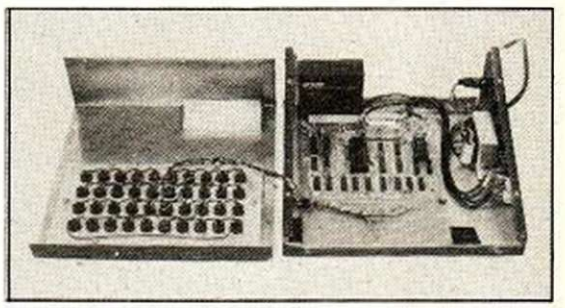
To decide the case dimensions I first took the printed-circuit board and plugged on the 16K RAM pack and measured from the front edge of the board to the back of the RAM. That gave me the depth. The width was decided by laying 10 of the key tops side by side and adding 1.125in. either side. I chose the height at the back of the case by measuring the height of the RAM pack and adding 0.5in. The front was decided to be 1in.

The key-switch panel was made from a sheet of aluminium 8.75in. by 5in. Four rows of 10 0.5in. holes were drilled in the panel, each row is 1in. apart: the holes in each row are 0.75in. apart. When the holes were drilled, five lengths of 0.25in.-by-0.25in. aluminium strip were glued between the rows. These strips act as spacers and allow the key panel to be suspended 0.25in. below the top cover — see figure 1.

The top cover was made to fit the main case with a 7.5in.-by-3.75in. hole cut in the top, 1in. from the front to allow the key tops to pass through. Four of the key switches complete with key tops and covers were fitted to the corner holes in the key panel, and the panel was then clamped into position under the top cover making sure the switches were free to move.

Clearance holes for 4BA fixings were then drilled through the top cover, through the key panel and through the aluminium strips to allow for fixing with 4BA nuts and bolts. I then cut holes in the side of the case to allow for tape recorder, and video sockets, also a rocker-type mains switch and fuse holder. When all the metal work was completed, the case, cover and key panel were given three coats of matt-black spray paint.

Next, I stripped the power supply and made a bracket of aluminium to fit over the transformer and mounted this on the right-hand side to the rear of the case. I fitted switches and sockets to the case, using miniature TV sockets for the video and new jack sockets for the recorder connections. I made a small modification to the video output to allow either a



monitor or a TV to be used with a small slide switch to switch between the two.

At this stage I also decided to make the modification on the PCB suggested by Sinclair to reverse the video display from black letters on a white background to white letters on a black background — much less eye-strain. It might have been better to have used a change-over switch to allow one to switch between the two. While using the ZX-80 in its original case, the voltage regulator became very hot after half an hour or more, so I removed it from the printed-circuit board, extended the leads on the regulator and mounted it on the side of the case, which now acts as a very efficient heat-sink.

The hole in the board left by the regulator was used as one of the fixing holes to mount

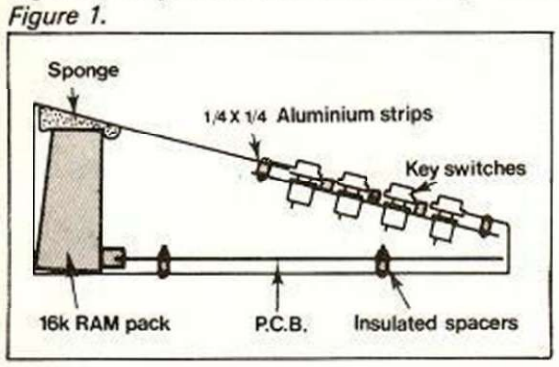
(continued on next page)

(continued from previous page)

the board to the base of the case. I drilled three more holes through the board to allow fixing. The 0.25in. insulated spacers put space between the board and the base of the case.

I then wired up the key panel — see figure 2 for details. It was simply a matter of duplicating the linkage from both sides of the printed-

Figure 1.



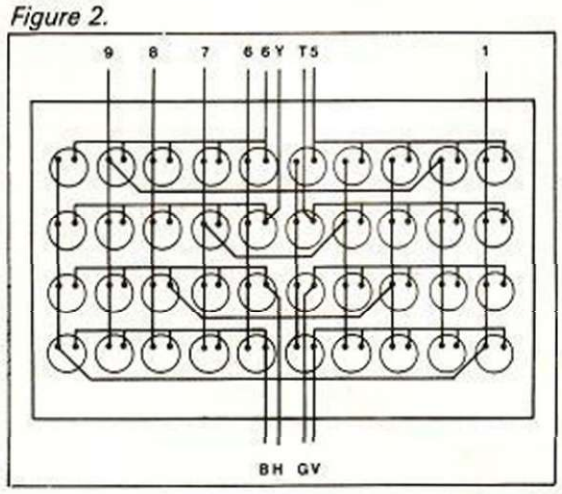
board key panel. After ensuring that all of the adhesive had been cleaned away from the key panel, I soldered 13 wires of different colours into the original keys which went to the computer circuit.

These wires were then laced together and soldered to the appropriate switches on the new key panel. The board was then mounted into the case and wired to the appropriate switches and sockets. To allow the RAM pack to be plugged on to the edge connector, I found it necessary to cut the two feet from the bottom of the RAM case.

Round-headed nuts and bolts secured the key panel to the top cover. Before the cover was finally fitted, a small piece of sponge was positioned immediately above the RAM. This ensures that the RAM is held firmly in place.

Finally the keyboard template, supplied with the 8K ROM, was cut up into its individual letters and placed in position on the new key tops, the Perspex covers snapped into place and the job was complete.

Figure 2.



Startling display

Anne Sarrag,
London SE18.

GENIE

I WROTE THE following program for my Video Genie. It creates a startling display, not very predictable from the listing itself. Although it is not very useful, apart from producing moving graphics, it could be incorporated into a game.

```
10    FOR A% = 155 TO 1 STEP - 1
20    FOR B% = 15360 TO 16383 STEP A%
30    POKE B%  191
40    NEXT B%
50    CLS
60    NEXT A%
70    GOTO 10
END
Press BREAK to escape the program.
```

Alien search

R Lawrence, S Haigh,
St Helier, Jersey.

ZX-81

ALIEN SEARCH uses most of the common functions of the ZX-81. The object of the game is to locate an alien starfighter within a force-field. The force-field strength determines the amount of shots — line 120 — and the hiding place — lines 150 to 170. That is, the larger the force-field strength, the harder the game. Your shots are put in as three co-ordinates, north, south and range, and line 330 determines if you hit the alien.

Laser guns may explode wasting shots or your battle computer may malfunction, causing the alien to move, hence you must start searching again.

These conditions are completely random and are determined in lines 675 to 700. The result of each shot is displayed by the subroutine lasers. The program ends with you hitting the alien or by running out of shots.

```
 10  LET     LASERS = 500
 20  PRINT   TAB 8; " "" ALIEN SEARCH"" ", TAB 39;
             "---------------" ,,, TAB 5; " "" R.
             LAWRENCE/S. HAIGH "" "
 30  PRINT
 40  PRINT
 50  PRINT
 60  PRINT   "YOU HAVE TRAPPED AN ALIEN","STAR-FIGHTER
             WITHIN YUR","FORCE FIELD.",,,,"YOU HAVE A
             DEFINED AMOUNT","OF LASER BOLTS TO SEEK",
             "OUT AND DESTROY HIM."
 70  PRINT
 80  PRINT
 90  PRINT   "SET FORCE FIELD STRENGTH"
100  INPUT   S
110  CLS
120  LET     N = INT (5+RND*(S/4))
125  SCROLL
130  PRINT   "YOU HAVE "; N; " PRIMED LASER GUNS"
140  LET     D = 1
150  LET     A = INT(RND*S)
160  LET     B = INT(RND*S)
170  LET     C = INT(RND*S)
180  SCROLL
190  PRINT   "ATTEMPT ";D
200  SCROLL
210  PRINT   "INPUT ""NORTH-SOUTH"" "; TAB 23;
220  INPUT   X
230  PRINT   X
240  SCROLL
250  PRINT   "INPUT ""EAST-WEST"" ";TAB 23;
260  INPUT   Y
270  PRINT   Y
280  SCROLL
290  PRINT   "INPUT ""RANGE"" "; TAB 23;
300  INPUT   Z
310  PRINT   Z
320  SCROLL
330  LET     W = (X-A) OR (Y-B) OR (Z-C)
340  IF      W = 0 THEN GOTO 430
350  GOTO    670
360  GOSUB   LASERS
370  LET     D = D+1
380  IF      D>N THEN GOTO 400
390  GOTO    380
400  FAST
402  PAUSE   100
403  POKE    16437,255
405  CLS
407  SLOW
410  PRINT   TAB 12; "URGENT",,,"BATTLE COMPUTERS
             REPORT THAT","ALL LASER GUNS NOW
             FIRED ",,,"ALIEN STAR-FIGHTER HAS SHOWN"
             ,"ITSELF AT",,"NORTH-SOUTH ",A, "EAST-WEST",
             B, "DISTANCE",C,,,"BUT IT IS NOW ESCAPING"
420  STOP
430  IF      D = 1 THEN GOTO 470
440  SCROLL
450  PRINT   " ""BOOM""YOU TOOK ";D;" SHOTS"
460  STOP
470  SCROLL
480  PRINT   " ""BOOM"" YOU TOOK ";D;" SHOT"
490  STOP
500  REM     LASERS
510  SCROLL
520  PRINT   "LASERS ARE SET"
530  SCROLL
540  IF      X>A THEN PRINT "NORTH"
550  IF      X<A THEN PRINT "SOUTH"
560  IF      X = A THEN PRINT "NORTH-SOUTH O.K."
570  SCROLL
580  IF      Y>B THEN PRINT "EAST"
590  IF      Y<B THEN PRINT "WEST"
600  IF      Y = B THEN PRINT "EAST-WEST O.K."
610  SCROLL
620  IF      Z>C THEN PRINT "RANGE TOO LONG"
630  IF      Z<C THEN PRINT "RANGE TOO SHORT"
640  IF      Z = C THEN PRINT "RANGE O.K."
650  SCROLL
660  RETURN
670  SCROLL
675  RAND
680  LET     F = INT(RND * 30)
690  IF      F>4 THEN GOTO 360
700  IF      F>=0 AND F<=2 THEN GOTO 760
710  SCROLL
720  PRINT   "BATTLE COMPUTER MAL-FUNCTION"
723  SCROLL
727  PRINT   "ALIEN NOW RE-POSITIONING"
730  LET     D = D + 1
740  SCROLL
750  GOTO    150
760  SCROLL
770  PRINT   "LASER GUN "; D ;"HIT BY ALIEN STRIKE"
780  SCROLL
790  SCROLL
800  PRINT   "GO ON TO GUN ";D + 1
810  SCROLL
820  GOTO    370
```

Memory economy

S A Nicholls, Keynsham, Bristol.

ZX-81

THIS PROGRAM demonstrates the memory saving which can be achieved on the ZX-81 1K. In its correct Basic form this program is too long to fit into 1K of memory. However, using codes in place of numbers where possible reduces the program length by 145 bytes and so enables it to run in 1K.

The program itself is not outstanding, but it does allow you to play a fair game of Oxo against the ZX-81 and is written without the need for machine-language routines.

The program is for 1K ZX-81 only. The computer has random 0 start — biased to the centre, and it will try to win. Decision time is less than five seconds. It gives an input prompt but will not accept occupied square inputs. It prints "Draw" after all squares are full, or, once stalemate is reached, after an X input. The computer can be beaten — there are two different win start positions.

```
1  REM ▛▌▒=*,ADG*▛G*▒A=A▛*▌D,▒G[R]∅∅0
POKE 16539,104
POKE 16540,122
2  PRINT "[1]□▒[2]□▒[3]□"
3  PRINT "▒▒▒▒▒▒▒▒"
4  PRINT "[4]□▒[5]□▒[6]□"
5  PRINT "▒▒▒▒▒▒▒▒"
6  PRINT "[7]□▒[8]□▒[9]□"
7  LET X = 16513
8  LET Q = PEEK 16396 + 256 * PEEK 16397
9  LET A = INT ( RND * CODE "/" + CODE "▛" )
10 POKE Q + PEEK (X+A), CODE "O"
11 FOR G = CODE "▛" TO CODE "▟"
12 PRINT AT CODE "▟", CODE "▄"; "[>]GO[<]"
15 INPUT A
16 PRINT AT CODE "▟", CODE "▀" ; "■■"
17 LET B = PEEK (X+A)
18 IF PEEK (Q+B) <> CODE "□" THEN GOTO CODE "£"
19 POKE Q+B, CODE "X"
20 FOR A = CODE "▛" TO CODE "▟"
21 FOR B = CODE "▛" TO CODE "-" STEP CODE "▀"
25 IF PEEK(Q + PEEK (X+B)) + PEEK ( Q + PEEK(X+B+CODE "▛"))
   + PEEK(Q + PEEK (X+B+CODE "▛"))<> PEEK(X+A+ CODE "/")
   THEN GOTO CODE "F"
34 FOR C = CODE "□" TO CODE "▛"
36 LET S = Q + PEEK (X+B+C)
38 IF PEEK S = CODE "□" THEN GOTO CODE "M"
40 NEXT C
41 PRINT "YOU WIN"
42 STOP
43 NEXT B
44 NEXT A
45 GOTO CODE "Q"
50 POKE S, CODE "O"
51 IF A = CODE "▛" THEN GOTO CODE "S"
52 NEXT G
54 PRINT "DRAW"
55 STOP
56 PRINT "I WIN"
```

Space = □
Inverse chrs. in boxes, [R] = inv.R   ▒ = Graphics shift A
Where possible numbers have been replaced by codes to save memory eg. CODE "/" = 24 saves 5 bytes

Moonlander

C Butler, Prittlewell, Essex.

ZX-81

IN THIS PROGRAM you have to land your space craft in a crater on the lunar surface without running out of fuel. You appear at a random position above the moon, and to fire your main descent rocket press "S" — a pleasing jet of flame will burst out from beneath you.

To move left and right press "A" and "D" respectively. To obtain a successful landing you must manoeuvre your craft over the crater — a grey rectangle — at a sufficiently slow speed. The computer acknowledges your success and displays the amount of fuel left. After a short pause you may start a new game.

You start with 200 fuel units and each time the main rocket is fired five units are lost. A left or right manoeuvre results in a unit loss of fuel.

The string in line 39 is a combination of the graphics found on keys "WQWQ6Q6ASSSA-6WQQWY6" and the character in line 9520 is a left arrow. Line 55 should read IF H <20.

```
0 REM MOONLANDER
1 PAUSE 100
5 LET F=200
10 LET X=INT(RND*36)
20 LET H=20
30 LET S=0
38 CLS
39 PRINT AT 20,0;"▄▟▙▟▄▄▄▄▒▒▒▒▄▟▙▟▙▟"
40 PLOT X,H
41 PLOT X+1,H
45 IF F>0 THEN IF INKEK$="S" THEN GOSUB 1000
48 IF F>0 THEN IF INKEY$="D" THEN GOSUB 9520
49 IF F>0 THEN IF INKEY$="A" THEN GOSUB 9560
55 IF H>4 THEN GOTO 4000
60 LET H=H-S
65 KET S=S+0.1
70 IF H>20 THEN LET H=20
90 GOTO 38
1000 LET S=S-0.2
1010 LET F=F-5
1020 PRINT TAB 32+X/2;"Y"
1050 RETURN
4010 PRINT AT 15,0;
5000 IF S<0.3 THEN PRINT "GREAT"
5040 IF S>=0.3 OR X<16 OR X>21 THEN PRINT "SMASH"
5050 PRINT "FUEL=";F
9510 GOTO 0
9520 PRINT AT 20-H/2+1,X/2-1.5;"<"
9530 LET X=X+1
9540 LET F=F-1
9550 RETURN
9560 PRINT ">"
9570 LET X=X-1
9580 LET F=F-1
9600 RETURN
READY.
```

Cricket score

M Fox, Walsall, West Midlands.

ZX-81

THIS PROGRAM is designed to run on a Sinclair ZX-81 with the 16K RAM pack. The program displays a cricket scoreboard and has many built-in features. The variables are,

O = overs; W = wickets; S = batting strike; BS = bowling strike; E = extras; L$(W) = fall of wickets; B(1) and B(2) are the batsmen scores; A$ = last man; X$ and Y$ are bowlers; B$ and C$ are batsmen; R = runs, L$ = last stand.

It is advisable to Goto 5000 for the start of each match.

When the program is in use, enter: 1,2,3,4,6 for the runs scored, 7 for the end of an over, 0 for a change of bowler — the computer will input a new name for the bowler with the strike — 5 for leg-byes and byes then enter the number of byes scored, 8 for a normal extra, 9 for a wicket. The computer will input the new last man, the new batsman's name — it takes the batsman with the strike — and if 50 is entered, any one of the following keys pressed will make the computer print the sign following:

L = lunch; T = tea; S = stumps; R = rain; B = bad light; D = drinks; N = new ball; E = erase.

Where "£" appears in the program, use a black graphics space. From 1000 to 4000, space is left for the user's own score cards and these can be assessed by Goto 2 then inputting the number 1 to 4 as appropriate. To obtain the normal score-board then use Goto 4.

When the 10th wicket falls, the computer will input a new last man, print this and then input any number before resetting for the next innings. For the 1K version of this program the variables are:

R = runs; W = wickets; O = overs; E = extras; A$ = last man; B$ and C$ are the bowlers; and LW = last wicket.

Enter 1,2,3,4,5,6 for runs scored, 7 for the end of an over, 8 for an extra, and 9 for a wicket — the computer will input the last man. A bowling change must be done by stopping the program and changing the variable manually.

(continued on page 65)

ZX81 SOFTWARE FROM VIDEO SOFTWARE LTD 1K & 16K

16K SOFTWARE

VIDEO-PLAN (ZX81 only). Performs the functions of an analysis book. Arithmetic functions include addition, subtraction, multiplication. Printer optional.

VIDEO-AD. Rotating display of 16 pages of advertising material. Set-up your own pages and change them as and when required.

VIDEO-GRAPH. Planning and design aid. Create pictures/charts/graphs and store within the program. Save on cassette. Combine pictures like an 'identikit'.

VIDEO-VIEW. Do it yourself teletext. Create pages of data. Store them within the program. Save on cassette. View on demand.

VIDEO-MAP. (ZX81 only). Educational game based on maps. Navigate your plane to its destination. Bomb the target and return to base.

FORCE-FIELD. (ZX81 only). Animated bombardment game. You control the force-field which protects your city against hostile UFOs.

SPACE-RACE. (ZX81 only). Party game for eight players. Rockets race to build stations in space. Winners gradually take over losers until only one winner remains.

FOOTBALL-LEAGUE. Realistic simulation of an entire season. Every match played and results shown with progressive league table. You give teams ratings for skill, effort, etc.

TEST-MATCH. Realistic simulation of a test match series. Dynamic scoreboard. Give each player your own ratings for skills, technique, etc.

STOCK-MARKET. (ZX81 only). An exciting game of skill and judgement. Buy and sell stocks and shares as prices change in response to world events.

PACK 1 — VIDEO-PLAN + VIDEO-AD.
PACK 2 — VIDEO-VIEW + VIDEO-GRAPH.
GAMESET — VIDEO-MAP + 5 GAMES.

1K PARTY TRICKS (ZX81 only) NEW! NEW!

If you don't have a 16K RAM this set of programs is for you. Ten separate programs — some games, some more serious. All completely original, all ten programs included in the price.

SHOOT	Take the penalty and watch the goalie try to save.
SKETCH	Draw an almost full screen picture and save on cassette.
NAME THE DAY	Give the date, the ZX81 names the day of the week.
TRAIN	For the very young who would like to drive a train.
ONGER-WONGER	Watch the ZX81 draw its own pictures and yours.
WEATHER	An endless variety of completely inaccurate weather forecasts.
UFO	Shoot down the UFO before he gets you.
WHO SHOT JR	An intriguing test of your powers of detection.
FIELD-GUN	Can you hit the target.
FOLLOW THAT	Follow the path traced by the ZX81.

NOTE: These programs are not suitable for ZX80.

NEW THIS MONTH

VIDEO-SKETCH (ZX81 16K only).
Move the cursor to any part of the screen. Draw or rub-out as you move it. Mix in text or graphics. Save picture in memory. Save picture sequence on cassette.

Std. @ £7.95. De-luxe @ £9.95.

NEWS FOR USERS

Those of you who have already voted with your cheque books may be interested in our 'top ten'. These are the best sellers so far:

1. VIDEO-VIEW
2. VIDEO-GRAPH
3. FORCE-FIELD
4. VIDEO-MAP
5. VIDEO-PLAN
6. FOOTBALL-LEAGUE
7. STOCK-MARKET
8. TEST-MATCH
9. SPACE-RACE
10. VIDEO-AD

Surprisingly some of the programs which we rate most highly are well down the list.

We expect our 1K programs to top this list soon. They are worth buying even if you have 16K.

PRICE LIST

ORDER CODE	*Manual*	*Std.*	*Lux*
SKETCH 81	—	7.95	9.95
PLAN 81	—	7.95	9.95
AD 81	—	7.95	9.95
GRAPH 81	—	5.95	7.95
VIEW 81	—	5.95	7.95
MAP 81	—	5.95	7.95
FORCE	—	3.95	5.95
SPACE	—	3.95	5.95
FOOT	—	3.95	5.95
TEST	—	3.95	5.95
STOCK	—	3.95	5.95
PARTY 1	1.95	4.95	6.95
PACK 1	—	—	17.95
PACK 2	—	—	13.95
GAMESET	—	—	19.95

Prices include VAT.
Mail order customers add £1.00 per order. (50p for manual only). Allow 28 days for delivery.

Std = cassette & manual. Lux = de luxe boxed sets.

VISIT US AT THE ZX MICROFAIR

STONE LANE,
KINVER,
STOURBRIDGE,
WEST MIDLANDS,
DY7 6EQ,
ENGLAND.

Tel: KINVER 2462.
Std. 038-483-2462.

VIDEO SOFTWARE LIMITED

Directors: P. Smith, B.A., D. J. Smith (*Director and Secretary*). Registered Number: 1085829 England. V.A.T. Reg. No. 278 0603 51

Personal callers welcome during office hours.
Send s.a.e. for further details.

ORDER FORM

Code	M/S/L	Qty.	Price	Total
P. & P.				

See above for codes

Your cheque no. .....

NAME.....

ADDRESS.....

.....

.....

(continued from page 63)

```
  1 REM "TEST"
  2 INPUT Z
  3 GOTO Z*1000
  4 GOSUB 890
  5 PRINT AT 0,1;B$;B(1),C$;B(2)
  7 PRINT
 10 PRINT R; "RUNS"
 20 PRINT "FOR ";W;" WICKETS"
 25 PRINT
 30 PRINT "ENGLAND LEAD BY ";153+R
 40 PRINT 0;" OVERS"
 50 PRINT "EXTRAS"; E
 60 PRINT "LAST MAN:"
 65 IF W= 10 THEN GOTO 350
 67 PRINT A$
 70 IF LEN A$<32 THEN PRINT
 80 PRINT "BOWLERS:"X$,,Y$
 81 PRINT
 82 IF W<>0 THEN PRINT AT 21,8; "LAST STAND ";LS
 84 IF W<>0 THEN PRINT AT 20,8;"THIS STAND ";R-VAL L$ (W)
 88 PRINT AT 12,0;"£"
 95 INPUT Z
 99 IF Z = 9 AND W=9 THEN GOTO 300
100 IF Z = 9 THEN GOTO 200
101 IF Z = 5 THEN GOTO 600
103 IF Z = 0 THEN GOTO 500
105 IF Z = 8 THEN GOTO 150
107 IF Z = 7 THEN GOTO 130
109 IF Z =50 THEN GOTO 440
110 LET R=R+Z
115 LET B(S)=B(S)+Z
117 IF Z = 1 OR Z = 3 OR Z=-1 OR Z=-3 THEN GOTO 225
120  GOTO 5
130  LET O=O+1
140  GOTO 9000
150  LET E=E+1
160  LET R=R+1
170  GOTO 5
205  LET W=W+1
207  IF W=1 THEN LET LS=R
208  IF W<>1 THEN LET LS=R-VAL L$(W-1)
210  INPUT A$
215  LET L$(W)=STR$ R
217  LET B(S)=0
219  IF S=1 THEN INPUT B$
220  IF S=2 THEN INPUT C$
223  GOTO 4
225  IF S=1 THEN GOTO 400
230  LET S=1
235  PLOT 0,43
240  UNPLOT 30,43
245  IF A=1 THEN RETURN
250  GOTO 5
300  LET W=W+1
305  INPUT A$
310  GOTO 5
350  INPUT Z
360  GOTO 5000
400  LET S=2
403  PLOT 30,43
407  UNPLOT 0,43
408  IF A=1 THEN RETURN
410  GOTO 5
440  IF INKEY$="" OR INKEY$=CHR$ 118 THEN GOTO 440
442 IF INKEY$="T" THEN LET H$="TEA"
443 IF INKEY$="S" THEN LET H$="STUMPS"
444 IF INKEY$="R" THEN LET H$="RAIN"
445 IF INKEY$="B" THEN LET H$="BAD LIGHT"
446 IF INKEY$="N" THEN LET H$="NEW BALL"
447 IF INKEY$="D" THEN LET H$="DRINKS"
448 IF INKEY$="E" THEN LET H$= "##########"
458 PRINT AT 3,16;H$
460 GOTO 5
500 INPUT Z$
510 IF BS = 1 THEN LET X$=Z$
530 IF BS = 2 THEN LET Y$=Z$
540 GOTO 4
600 INPUT Z
605 LET E=E+Z
610 LET R=R+Z
620 IF Z=1 OR Z=-1 OR Z=3 OR Z=-3 THEN GOTO 225
630 GOTO 5
900 FOR N=0 TO 21
910 PRINT AT N,0; "################################"
920 NEXT N
930 GOSUB 6000
940 RETURN
4990 STOP
5000 LET W=0
5010 LET R=0
5015 CLS
5020 LET O=0
5030 LET E=0
5040 LET A$=""
5042 LET S=1
5047 LET BS=1
5050 PRINT "BATSMAN?"
5060 INPUT B$
5080 INPUT C$
5090 DIM B(2)
5100 DIM L$(10,3)
5110 PRINT "BOWLERS?"
5120 INPUT X$
5130 INPUT Y$
5140 GOTO 4
6000 PRINT AT 14,0;"FALL OF WICKETS"
6100 LET A=2
6110 RETURN
9010 IFBS=1 THEN GOTO 9060
9020 LET BS=1
9030 PLOT 30,21
9040 UNPLOT 30,90
9050 IF A=1 THEN RETURN
9055 GOTO 255
9060 LET BS=2
9070 PLOT 30,19
9080 UNPLOT 30,21
9090 IF A=1 THEN RETURN
9100 GOTO 225
```

```
  5 REM"TEST"
 10 PRINT AT 0,0;R;" RUNS"
 20 PRINT W;" WICKETS"
 30 PRINT "RUNS REQUIRED ";R-130 (OR ENGLAND LEADS BY)
 40 PRINT O;" OVERS"
 50 PRINT "EXTRAS ";E
 60 PRINT "LAST MAN";A$
 70 PRINT "LAST WICKET ";LW
 80 PRINT "BOWLERS;", B$,,C$
 90 INPUT Z
100 IF Z=9 THEN GOTO 200
105 IF Z=7 THEN GOTO 130
107 IF Z=8 THEN GOTO 150
110 LET R=R+Z
120 GOTO 1
130 LET O=O+1
140 GOTO 1
150 LET E=E+1
160 LET R=R+1
170 GOTO 1
200 LET W=W+1
210 INPUT A$
215 LET LW=R
220 GOTO 1
# = pound sign
```

Writing wrongs

D Lawrence,
Highfield, Southampton.

ZX-81

JAMES TYLER'S RENUMBER routine published on page 67 of your November 1981 issue is a neat piece of work but it has the slight disadvantage that it will not run on a ZX-81.

The reason is simple. In designing the program, James Tyler has assumed that the end-of-file indicator for a Basic program consists of the Newline of the last program line plus two more halt codes — 119. He also apparently believes that in the absence of a Basic program, memory addresses 16509 and 16510 — the normal location of the first line number — are loaded with 118. Unfortunately, he is wrong on both counts.

In the absence of a Basic program only 16509 is set to 118 and the end-of-file indicator is the Newline of the final program line followed by one halt. The routine never finds the end of program indicator it is seeking and goes on searching up the memory until it crashes.

The answer to the problem is to shorten the routine by removing one of the loops which examine addresses for a halt. Thus, in the absence of a Basic listing, the routine returns to Basic on finding a single 118 at address 16509 or, if there is a Basic program, on finding two consecutive 118s at any given point.

In addition to these necessary changes given my version, the original loading programs are unnecessarily complex for a machine-code routine of this length. Instead of two consecutive programs, my Basic program will suffice and, in addition, make the editing of any mistakes far more simple.

An optional

425 PRINT (S + (I-1)/3), PEEK (S + (I-1)/3)

will display the address and what has been loaded there.

The procedure is as follows: lower RAMtop the number of bytes necessary by Poking

(continued on page 67)

ZX81 16k SOFTWARE

PACK 16/ 1 includes all of:
AIR TRAFFIC CONTROL: Animated radar screen of busy airport shown, you must bring planes into land; INVADERS SELF PLAY; PHONEBOOK — keep friends' and relatives' numbers on cassette; DATE '81 — computer dating program. Who will it pick for you?
ALL ONLY **£4.95**

PACK 16/ 2 includes all of:
ADVENTURE ATLANTIC: You may become very rich or you may be marooned forever; BREAKOUT: SQUASH PRACTICE; LANGUAGE TRANSLATOR translates any European language to any other; COMPUTAPRINT — use this program to predict results of horse races, football pools, etc.
ALL ONLY **£4.95**

PACK 16/ 3 includes all of:
INDI 500; video roadracer; DRAUGHTS; Computer Chequers; BATTLESHIPS — nautical warfare on your own computer.
MASTERMIND — Brain Teaser, see if you can beat a microelectronic mind.
ALL ONLY **£4.95**

The breakthrough you've waited for:
PROGRAM THE ZX81 IN ENGLISH!!!
With GAMAL 81 you can now write adventure programs in hours not weeks and with GAMAL 81 you'll have every adventure you'll ever want for the price of one.
Comes on cassette with instruction book, **£7.95**

All our software comes with full instructions and is SAVEd and ready to RUN, no need to spend hours laboriously typing in from books.

CONTROL TECHNOLOGY — PERSONAL COMPUTER SCIENCE

ZX-81

Cassette 1½

A super value cassette of 16K and 1K software written in Machine Code and Basic.
Includes:
React, Invaders, Phantom Aliens, Maze of Death, Planetlander, I Ching, Hangman, Invaders, Laser Base, rectangle plus more.
ALL ONLY **£4.95**

Tapebook 50, Version 3

50 programs for the IKRAM ZX81.
Latest version includes:
SQUASH, BREAKOUT, COLUMBIA, SPLAT, INTEGRATION, CREDIT CARD CALCULATOR, BANK A/C, VATCHECK, TANK BATTLE, TORPEDO, HEXLOADER, BINARY CONVERTER, AND LOTS, LOTS MORE.
Still amazing value at **£6.95** the lot.

PACK 16/1 + 16/2 + 16/3
(any two only £5.95)
ALL THREE ONLY
£6.95

TAPEBOOK 50.3 + CASSETTE 1½
BOTH ONLY
£9.95

BOTH OFFERS ARE ONLY **£13.95**
TO ALL ZX81 OWNERS

All prices include VAT and postage and packing

CONTROL TECHNOLOGY,
39 Gloucester Road, Gee Cross,
Hyde, Cheshire SK14 5JG
061-368 7558

(continued from page 65)

16388,229 and 16389,127 — 1K:67. Then enter New to reset RAMtop and enter the Basic program and save it — just in case anything goes wrong.

Run the program and the code will be inserted above RAMtop. The start address is 32741 — 17381:1K. If you have made some error in the code, simply reload the program — always assuming that RAMtop is still where you want it — and edit the string, remembering that each decimal value should occupy three spaces.

Delete the Basic program and the routine will renumber anything you care to enter, on the command

PRINT USR 32741 -- 1K:17381

The method saves seven bytes on the machine code, nine lines of Basic and the string occupies less space than the suggested numerical array.

```
DECIMAL         HEX           INSTR          COMMENTS

33,125,64       21,7D,40      LD HL,407D     ;address of first line number
17,10,00        11,0A,00      LD DE,0A       ;desired first line number in DE
126             7E            LD A, (HL)     ;is it a halt
254,118         FE,76         CP 76
200             C8            RET Z          ;if so return to Basic
114             72            LD (HL),D      ;load new line number
35              23            INC HL
115             73            LD (HL),E
6,10            06,0A         LD B,0A        ;create next line number
19              13            INC DE
16,253          10,FD         DJNZ
35              23            INC HL         ;test for end of program line
126             7E            LDA,(HL)
254,118         FE,76         CP X 76
32,250          20 FA         JRNZ
35              23            INC HL         ;move to next possible line
number
24,235          18,EB         JR             ;jump to next check

100 LET C$="033125064017010000126254118200114035ll
    500601001901625303512625411803225003502423S" (the decimal code
gien)
200 PRINT "START ADDRESS?"
250 INPUT S (New RAMTOP address)
300 FOR I=1 TO LEN C$ STEP 3
350 LET C=VAL C$(I TO I+2)
400 POKE (S+(I-1)/3),C
450 NEXT I
```

Key to understanding

R J Fernandez,
Montrose, Angus.

ATOM

A SIMPLE, 2.5K Basic disassembler has helped me uncover some of the operating-system routines which read the Atom keyboard. The first problem I encountered is the absence of a keyboard Get command — not the Get byte cassette command. This is easily overcome using a simple machine-code routine — as easy as Basic if you use the excellent Atom disassembler.

The following routine uses the OSEcho routine at # FFEbH and stores the ASCII value at # 80H.

```
20 Eb FF  JSR# FFEb  ; Get key into the
                       accumulator
85 80     STA# 80    ; Store code at 80H
60        RTS
```

The character can be removed using:

$A = $ (?# 80)

where $A is a previously dimensioned string variable. It would be easier just to consider the code when deciding which key was pressed, e.g.,

IF ?# 81 = CH"A"

A more annoying problem, however, is to read a key without stopping the program — one of the problems of a keyboard which is not buffered. However, there is a routine in ROM used by the OSRDCH or read-character routine which returns the position of the depressed key on the keyboard matrix — figure 1.

The routine at # FE71H returns in the Y register the position of the key on the matrix counting from SP which is position 0, through A which is position 33D, to ESC at position 59D. Register X contains the row number # 1 of the depressed key and the accumulator contains a value corresponding to the bit position of possibilities — multi-player games on the same keyboard, multiple actions simultaneously in a game and so on.

Bit Position

		7	6	5	4	3	2	1	0
Bit position values	HEX	80	40	20	10	8	4	2	1
	DEC	128	64	32	16	8	4	2	1

The boxes contain the values associated with each bit.

Figure 2. Bit values

A final warning — if you try to write the routine in Basic, all the keys in column 5 act as the ESC key during the scan, and stop the program if one of them is depressed.

While working in ROM, I discovered several of the routines and tables used by the system software and I have included some of the addresses in table 1.

The following routine can be used to build up the keyboard bit map:

Op-codes Label Mnemonics

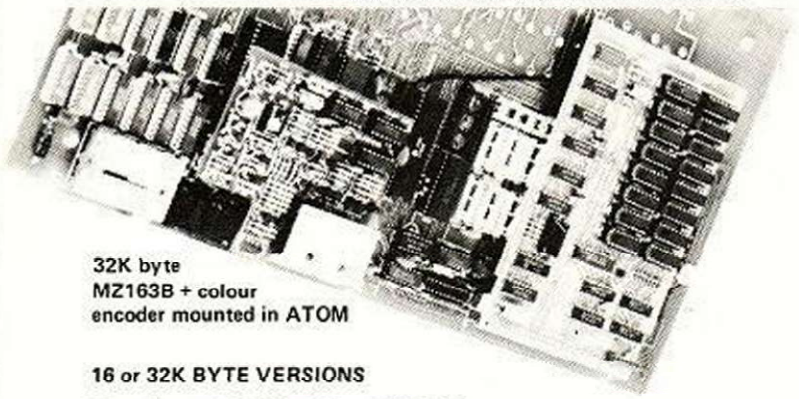
```
A2 09          LDX1M# 9; Load counter
8A       : LLI TXA
18             CLC
6D 00 B0       ADC # B000  Drive key-
8D 00 B0       STA # B000  board row
AD 01 B0       LDA # B001; Read row
95 80          STA # 80, X
A9 F0          LDAIM# FO  Zero lower
2D 00 B0       AND # B000 nybble of
8D 00 B0       STA # B000 Port A
CA             DEX
10 E9          BPL LL1; Finished?
60             RTS
```

Once a bit map of the keyboard has been made, it is a simple matter to check for any key: take its row value and And it — using the logical bitwise And command in Basic — with the value corresponding to the key bit

(continued on page 69)

This memory is made for your Atom

OR OTHER 1MHz 6502/6800/6809 SYSTEM



32K byte
MZ163B + colour
encoder mounted in ATOM

16 or 32K BYTE VERSIONS

Expand your ATOM to 28 or 38K RAM

Ideal for Word Processing, Chess programs and Business Software.

Fully Compatible with other Acorn ATOM software and hardware

Versions available to fit inside the ATOM while still leaving room for other extensions such as the Acorn ATOM colour encoder board.

Eurocard rack mounting types also available

Fully buffered address & data busses.

PRICES: INCLUDING U.K. P&P &15% VAT

MZ163A 16K Built & tested to fit inside ATOM'S case	£59.50
MZ163B 32K ,, ,, ...	£74.00
MZ163C 16K Built & tested, Eurocard rack mounting	£62.00
MZ163D 32K ,, ,, ,, ,,	£76.50
MZ163E Bare PCB to build any of above with data	£23.00
MP100 DC/DC converter; powers any MZ163 board from unregulated 8V supply such as the ATOM mains adaptor	£8.50

S.A.E. for further details.

Quality Support for ZX, Atom

THE ZX80 MAGIC BOOK *With 8K ROM/ZX81 Supplement*
Games programs, computer music, converting programs written in other BASICS, improving the picture RAM & I/0 circuits, and much more £4.75

GETTING ACQUAINTED WITH YOUR ZX81
75 + programs including Draughts; by Tim Hartnell £4.95

MASTERING MACHINE CODE ON YOUR ZX80/81
180 pages of immense value to beginner and expert alike. £5.95

THE ATOM MAGIC BOOK
A wealth of games and other programs: storing speech in your ATOM, converting programs written in other BASICs tape recoding hints, and many more useful hardware tips. £5.50

GETTING ACQUAINTED WITH YOUR ACORN ATOM
By Tim Hartnell and Trevor Sharples.80 programs including Draughts! £7.95

23+23 WAY ZX80/81 EDGE CONNECTOR SOCKET	£3.50
23+23 WAY ZX80/81 GOLD PLATED PLUG EXTENSION	£3.50
32+32 WAY DIN41612 ATOM BUS CONNECTORS;	
PCB plug with 90° PCB terminals	£2.85
Wire wrap/solder socket	£4.50
ATOM BUS BUFFER IC SET DP8304+2x 81LS95 + 74LS30	£7.55

BARCLAYCARD VISA

ALL PRICES INCLUDE U.K.P&P +15% VAT WHERE APPLICABLE.
PAYMENT WITH ORDER PLEASE.

TIMEDATA LTD 57 Swallowdale, Basildon, Essex. SS16 5JG Tel; (0268) 411125 (MON-FRI)

TIMEDATA

ZX-81 OWNERS
ACCESS TO THE OUTSIDE WORLD

Using our programmable **INPUT/OUTPUT** controller based on the Z80AP10, you can use up to 16 programmable input/output lines, all TTL compatible. Control of the port can be carried out from within programmes giving a whole new dimension of uses for your ZX-81 computer.

The port can be used **WITH** or **WITHOUT** the 16K **RAM PACK** & **PRINTER.**

Available in kit form or assembled, and comes complete with instructions, a pack of software notes and circuit ideas.

£10.99 IN KIT FORM
£12.99 ASSEMBLED

50p Post + Packing + Add 15% VAT

Snap on Analogue card and Relay board available shortly. Send SAE for details.

VISA

THURNALL (ELECTRONICS) ENG.
DEPT Y, 95 LIVERPOOL ROAD,
CADISHEAD, MANCHESTER M30 5BG
TEL: 061-775 4461 (24 hour)

ZX80/81 HARDWARE

Description of Kit (Price includes VAT, but add 80p postage)	*Price* £ p
1.0 amp, 5.0 volt power supply. Requires 9.0 volt transformer	8.03
16 bit latched LED board	9.80
Edge connector for LED board	3.00
40 key full size keyboard for ZX80, ZX81	19.95
Edge connector to fit above	1.95
4 rubber feet for keyboard	0.24
Spare key and keytop	0.48
Case for keyboard	Enquire
24 line In/Out port	13.50
In/Out edge connector	3.00
23 way edge connector for ZX80, ZX81	2.95
Motherboard	10.44
Voltage regulator kit for motherboard	2.40
Connector for motherboard	2.95
Digital to analogue converter board	16.95
One digital to analogue and buffer IC	6.89
23 way male connector, single	1.30
23 way male connector, double	1.60
Pair of connectors for ZX81 keyboard	1.50
24 line In/Out port (ZX81 only)	16.95

All the above are available built — see catalogue.

BOOKS (post free)

Getting Acquainted With Your ZX81. Tim Hartnell	£4.95
Mastering Machine Code On Your ZX81. Tony Baker	£5.95

The Sinclair ZX81. Programming for Real Applications. Randle Hurley. 170 pages. £6.95. Tape £9.95 (post 40p)

Send 10" × 7" SAE for free illustrated catalogue

REDDITCH ELECTRONICS
21 Ferney Hill Avenue,
Redditch, Worcs. B97 4RU
Telephone: Redditch (0527) 61240

(continued from page 67)

position. See figure 2 for these bit values.

If the result of the And operation is 0, the key is being pressed. Bits 6 and 7 of all these key row values represent the conditions of the control and shift keys at the time of the scan — that is, if the value is less than 128D then shift is pressed; if less than 192D, CTRL is pressed.

For example, to check if A is pressed, after running the routine, do the following from Basic:

- Consider the value at # 83H — row 3.
- And value with 8D — bit position 3, column 3.
- If result 0, key is pressed.
- Check if control or shift are pressed as described, if necessary.

Figure 1. The keyboard matrix.

Row number	Bit position 0	1	2	3	4	5
9		3	—	G	Q	ESC
8		2	,	F	P	Z
7		1	;	E	O	Y
6		0	:	D	N	X
5	Lock	DEL	9	C	M	W
4		COPY	8	B	L	V
3	]	RET	7	A	K	U
2			6		J	T
1	[		5	/	I	S
0	SP		4	.	H	R
	0	1	2	3	4	5

Column number

Note: Read column number then row number for position code in Y after routine at # FE71H. E.g., A = 33D.

This approach to reading the keyboard opens a whole new range of key-column reading from column 0 which corresponds to bit 0, to column 5 which corresponds to bit 5. For example, if the A key is depressed register Y = 33, register X = 4 and Acc = 8 — i.e., column 3.

The following machine-code routine reads the keyboard and stores the Acc, X and Y in # 80E, # 81H and # 82H respectively, although only the Y register value is actually needed to find the depressed key.

```
20 71 FE   JSR# FE71
85 80      STA# 80
86 81      STX# 81
84 82      STY# 82
60         RTS
```

Note that the values are unaffected by shift and control, so to check for a shifted key, the value at B001D is less than 128D, and for a control key the value is less than 192.

If only an alphabet or number key, or for that matter any key with ASC11 code between # 30H and # 5AH, is being checked, the ASC11 code can be obtained by adding 14D to the value in the Y register. The one problem with the second routine is that only one key can be read at a time. This can be solved by using a small routine to make a bit map of the keyboard matrix.

The basic idea is to store the numbers 1 to 10D in sequence in the lower nybble of # B000D — port A of the 8255 PPIA — to drive each row of the matrix in turn and each time read the value at port B, which corresponds to the keyboard column, and store this in a buffer area to be looked up by the calling program.

Each of the 10 row values is stored in one byte, thus the whole keyboard requires only 10 bytes. My own preference is to use the memory between # 80H and # AF in zero page which is free.

Table 1.

# FDECH	—	Scroll routine. Fill the screen with characters and try LINK# FDEC. LDY@0; JSR# FE16 produces half screen scroll.
# FE6BH	—	Screen synchronisation routine.
# FD1AH	—	CTRL-G routine.
# FD0BH	—	Start screen, ACK routine.
# FD11H	—	Page mode off, S1.
# FD0BH	—	ESC routine.
# FF3FH	—	RES routine.
# C9D8H	—	Reset service routine.
# C9EYH	—	Basic error routine.
# C000H	—	Base of command table.
# D000H	—	Base of FP command table.
# F000H	—	Base of command table.
# F8BEH	—	Base of command table.

The # represents hexadecimal; the @ immediate mode or Atom standard.

Screen print

N Higham,
Eccles, Manchester.

PET

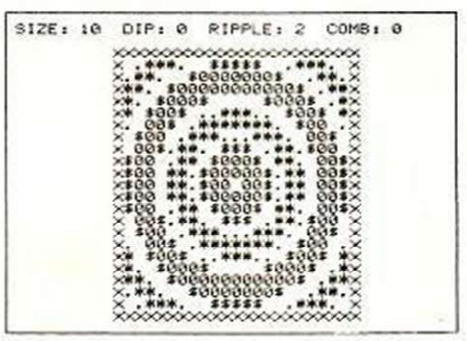
THIS PROGRAM for all Pets — except old ROM — prints the contents of the screen on a Commodore 3022 or 4022 printer. When loaded, or appended to an existing program and called by Gosub 63000, the screen is dumped to the printer in the centre of the paper and surrounded by a box.

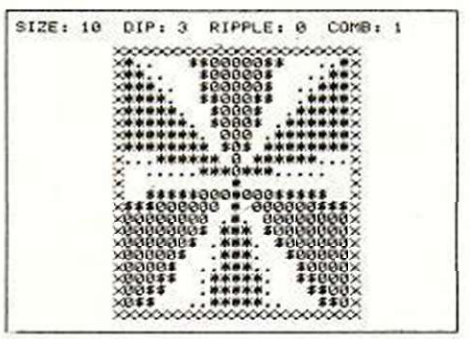
The routine is intelligent in that it executes a delay, the length of which depends linearly on the amount of reverse-field characters on the line just printed. This is to avoid the print head burning out if the screen contains a large amount of reverse field.

Line 63010 reduces the line spacing to give vertically contiguous graphics and line 63130 resets it. The printing can be halted at any time by pressing 'S' and restarted by pressing any key.

Line 63075 allows for a bug in the 4022 printer in that CHRS(254) prints a space instead of the required graphics character.

```
63000 REM ---- 'SCREENPRINT'  BY  N.J.HIGHAM ----
63005 REM  PRESS 'S' TO HALT PRINTING, ANY KEY TO RESTART
63007 CLR:P1=24:P2=36:REM FOR 4022
63008 REM FOR 3022 P1=18:P2=24
63010 OPEN6,4,6:PRINT#6,CHR$(P1):CLOSE6:PRINT"■"
63020 T=18:Z$="┌":FORI=1TO40:Z$=Z$+"─":NEXT:OPEN4,4:PRINT#4,TAB(T)Z$"┐"
63030 PRINT#4,TAB(T)"│ ";:DEFFND(X)=-(R>5)*(2000+400*X)
63040 E=33767:FORI=32768TOE:A=PEEK(I)
63050 GETA$:IFA$="S"THENPOKE158,0:WAIT158,1:GETA$:POKE158,0
63060 IFF=0ANDA>127THENF=1:PRINT#4,CHR$(T);:GOTO63075
63070 IFF=1ANDA<128THENF=0:PRINT#4,CHR$(146);
63075 IFA=254THENB$="■":GOTO63100
63080 B=-(A+64)*(A<64)-(A+128)*(63<AANDA<126)-(A+64)*(125<AANDA<128)
63090 B=B-(A-64)*(127<AANDA<191)-A*(190<AANDA<255)-191*(A=255):B$=CHR$(B)
63100 R=R+F:PRINT#4,B$;:X=X+1:IFX<40GOTO63120
63110 FORD=1TOFND(R):NEXT:R=0:X=0:F=0:PRINT#4,"■│":IFI<ETHENPRINT#4,TAB(T)"│ ";
63120 NEXT:Z$="└":FORI=1TO40:Z$=Z$+"─":NEXT:PRINT#4,TAB(T)Z$"┘":PRINT#4:CLOSE4
63130 OPEN6,4,6:PRINT#6,CHR$(P2):CLOSE6
63200 OPEN4,4:PRINT"□■RETURN■: P/FEED":PRINT"■SPACE■:  END
63210 A=PEEK(151):IFA=27THENPRINT#4
63220 IFA=6THENCLOSE4:POKE158,0:END
63230 GOTO63210
```





Storage technique

John Eade,
Stroud, Gloucestershire.

ZX-81

THE FREE-MEMORY routine by Paul Brittain, November 1981 page 67, is intended for use when writing programs. It must not hamper the program being written. If it is stored in a Rem statement in the first line, it will change all program addresses when finally deleted. In any case, there may be another machine-code routine which must occupy that position because of the absolute addresses within it.

There is, however, another way of storing machine-code routines which I have not seen mentioned elsewhere. This is simply to Poke it into any program line Rem statement and call it from the previous line using the NXTLIN variable — see ZX-81 manual page 178. Enter the two lines as follows:

```
9989 LET A = (PEEK 16425 + 256 × PEEK
     16426 + 5)
9990 REM XXXXXXXXXXXXXXXXXXXXX
     (that is 21 Xs)
9991 FOR N = A TO A + 21
9992 INPUT B
9993 POKE N,B
9994 PRINT PEEK N
9995 NEXT N
GOTO 9989
```

Enter: 175, 103, 111, 57, 237, 75, 28, 64, 237, 66, 229, 193, 253, 33, 0, 64, 62, 30, 237, 71, 201

Delete lines 9991, 9992, 9993, 9994, 9995

Edit line 9980 — delete LET A = and substitute PRINT USR

Do not forget to run the whole program if you can, so that the display file — if RAM is greater than 3.25K — and variables take the required space.

(continued on next page)

(continued from previous page)

Cost price

Ian McAipine,
Portadown,
County Armagh.

ZX-81

I AM 14 YEARS old, and my father and mother have a do-it-yourself and crafts shop which sells many small items. After buying any stock, they have to estimate their mark-up and VAT and, finally, the selling price of each one.

My father had set his heart on proving that a calculator is faster than my Sinclair ZX-81, so I set out to prove him wrong. After buzzing around the keyboard for a few hours, I produced Cost Price.

The program first asks you to input the cost price. If it was 50p, then you would input 0.50, or if the cost price was £6.72 you would input 6.72. Then you are asked to input your required mark-up. You would input 1 for 50 percent, 2 for 60 percent, 3 for 75 percent, or 4 for 100 percent.

These percentages can be easily changed to suit your own requirements. Finally, you are asked to input the quantity. The computer then prints out the original cost price, on the left-hand side of the screen, and in the middle it prints the price at which you should sell each one, including your mark-up, and VAT.

When you input the cost price, you do not need to input the VAT, as the computer calculates the VAT for you, and includes it on to the recommended selling price. After about seven seconds, the computer returns to ask you to input the cost price again.

When I showed this program to my father, he threw his calculator in the bin. This program will run on an unexpanded ZX-81. The delay, before returning to the original question again, can be shortened or lengthened, by adjusting the Pause on line 160.

```
  4  REM COST PRICE
  5  PRINT "PLEASE INPUT COST PRICE"
 10  INPUT E
 12  IF E<=0 THEN GOTO 10
 15  CLS
 20  PRINT "MARK UP, 1=50;2=60;3=75;4=100"
 30  INPUT F
 31 CLS
 32 PRINT "INPUT QUANTITY"
 35 INPUT G
 37 CLS
 40 LET A=(E/2+E)/20*3
 50 LET B=(E/5*3+E)/20*3
 60 LET C=(E/4*3+E)/20*3
 70 LET D=(E+E)/20*3
 80 IF F=1 THEN GOTO 120
 90 IF F=2 THEN GOTO 130
100 IF F=3 THEN GOTO 140
110 IF F=4 THEN GOTO 150
120 PRINT "£";E,"£";(E+E/2+A)/G
125 GOTO 160
130 PRINT "£";E,"£";(E+E/5*3+B)/G
135 GOTO 160
140 PRINT "£";E,"£";(E+E/4*3+C)/G
145 GOTO 160
150 PRINT "£";E,"£";(E+E+D)/G
160 PAUSE 350
170 CLS
180 GOTO 5
```

Wild dogs

C D Carter,
Bargoed, Mid Glamorgan.

ZX-81

THIS, MY FAVOURITE program, makes use of the fact that a computer can make logical movements. It uses these movements to make a very authentic chase-type game. The program makes full use of plot and unplot and simple calculation Basic.

The game is relatively easy to play and starts by putting you roughly in the centre of the screen. When you are confident enough to manage the arrow movement keys and hit the correct one very time, you press the Newline key. The computer will put its two characters on the screen. These characters will the move towards you, and it is then up to you to dodge them. You have a slightly faster speed than them.

When one of them thinks he is starting to catch you, he will accelerate. You still have the advantage while travelling in a straight line. When the game has finished, it will give you a rough estimate of the time you lasted in seconds, before being caught.

```
1       LET Q=60
2       LET W=40
3       LET CC=0
5       LET X=2
6       LET Y=X
10      LET A=20
20      LET B=A
21      PRINT AT 10,10;"WILD DOGS"
22      PAUSE 100
23      CLS
24      PLOT A,B
25      INPUT A$
30      LET A$=INKEY$
40      UNPLOT A,B
50      IF A$="5" THEN LET A=A-3
60      IF A$="6" THEN LET B=B-3
70      IF A$="7" THEN LET B=B+3
80      IF A$="8" THEN LET A=A+3
90      PLOT A,B
95      GOSUB 105
97      GOSUB 200
98      LET CC=CC+1
100     GOTO 30
105     UNPLOT X,Y
110     IF B>Y THEN LET Y=Y+2
120     IF A>X THEN LET X=X+1
130     IF A<X THEN LET X=X-2
140     IF B<Y THEN LET Y=Y-1
150     IF X=A AND Y=B THEN GOTO 300
160     PLOT X,Y
170     RETURN
200     UNPLOT Q,W
210     IF A>Q THEN LET Q=Q+2
220     IF B>W THEN LET W=W+1
230     IF A<Q THEN LET Q=Q-1
240     IF B<W THEN LET W=W-2
250     IF Q=A AND W=B THEN GOTO 300
260     PLOT Q,W
270     RETURN
300     PRINT AT 13,0;"YOU LASTED"; INT(CC/1.89);" SECS BEFORE THE"
310     PRINT AT 14,6;"WILD DOGS CAUGHT YOU"
```

External inputs

Ian McLean,
Preston, Lancashire.

ZX-81

THE ZX-81 KEYBOARD works on an X, Y grid system — see figure 1 — and does not require an electrical pulse, merely a connection between the X and Y terminals. A list of connections is given in table 1, and the terminals in figure 2.

For me, a port represented a programming and memory problem. My ideas require no software changes to existing programs, and only a small hardware connection to the connector inside the machine. The possibility of using a light-pen, temperature monitor, Space Invader-type hand-held controls and keyboard at the same time opened an exciting door into the world of interactive computing.

A=5,D	K=3,G	U=2,E	4=2,A
B=1,H	L=4,G	V=1,F	5=1,A
C=2,F	M=3,H	W=4,B	6=1,C
D=2,F	N=2,H	X=3,F	7=2,C
E=3,B	O=4,E	Y=1,E	8=3,C
F=2,D	P=5,E	Z=4,F	9=4,C
G=1,D	Q=5,B	0=5,C	.=4,H
H=1,G	R=2,B	1=5,A	newline=5,G
I=3,E	S=4,D	2=4,A	space=5,H
J=2,G	T=1,B	3=3,A	shift=5,F

Table 1.

Inkey$ and sometimes Input can be used. I found that Inkey$ was the best for the controls in games like Meteors on the Sinclair games cassette 1. Inkey$ was used for the temperature monitor which triggers at a pre-set temperature, and can, under software control, be used as a temperature alarm. Inkey$ was also used for the light-pen to monitor the string input to see when the button was pressed and the value entered.

Input was found useful in separating keyboard and peripheral data. Because Input requires Newline after it, I did not connect Newline to the peripherals to avoid entering data accidentally. Even in this state, unwanted data could still be entered on to the screen.

As the Input statement only requires data during its execution, any data at the input immediately before its execution can automatically be rejected. In listing 1, line 20 does this. It waits for a clear input bus before allowing the Input statement to continue. Table 2 lists the tools and components required. The more experienced may wish to modify the hardware to his specific requirements.

Quantity	Component
1	metre ribbon cable — 20 core
2	IL75 opto isolators
4	BC107/8/9 transistors
1	piece of veroboard
1	ORP12 photo-resistor
1	TH3 thermosistor
2	220K pre-set potentiometer
1	Low-power soldering iron
1	length of solder
1	pair of wire strippers

Table 2 above, and below, figure 4.

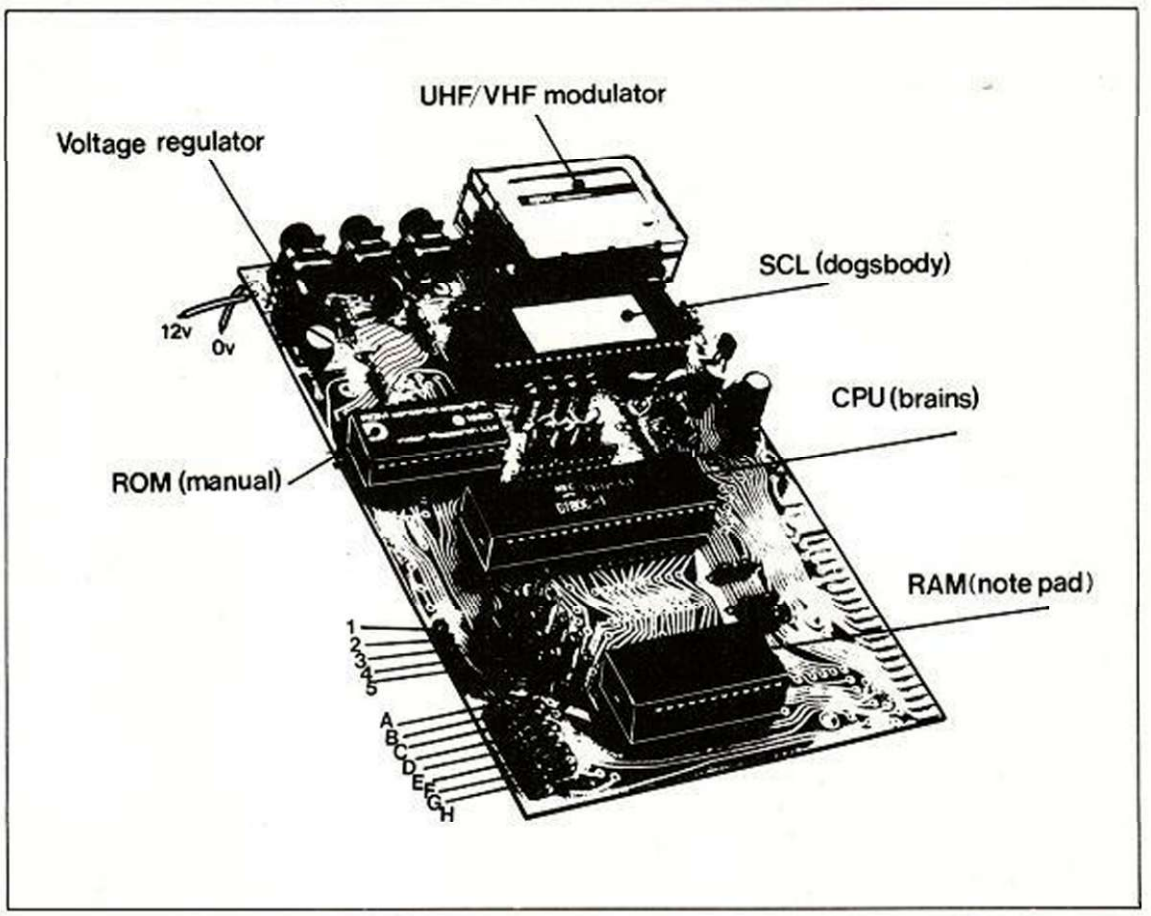


Figure 2 above, and below, figure 1.

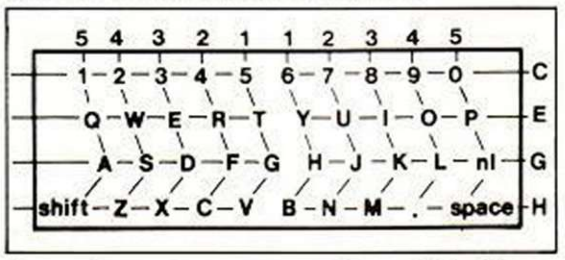


Figure 3 gives the circuit diagrams for the push buttons, light-pen and temperature monitor. Note that the connections are not given, as different Inkey$ values may be allocated to each switch. Figure 4, however, shows the connections I made, as an example.

Figure 2 shows the necessary internal connections inside the machine. The ribbon cable is soldered on to the copper side of the printed-circuit board to retain the keyboard connection on the component side. On the 1K version, two of the wires were connected to the 12V and 0V lines. It is helpful to make a note of the cable connections and corresponding colour codes for future reference. Pass the cable underneath the extra memory connector at the back and out through the hole.

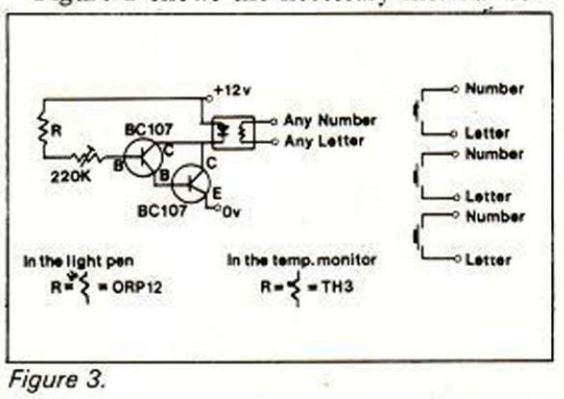
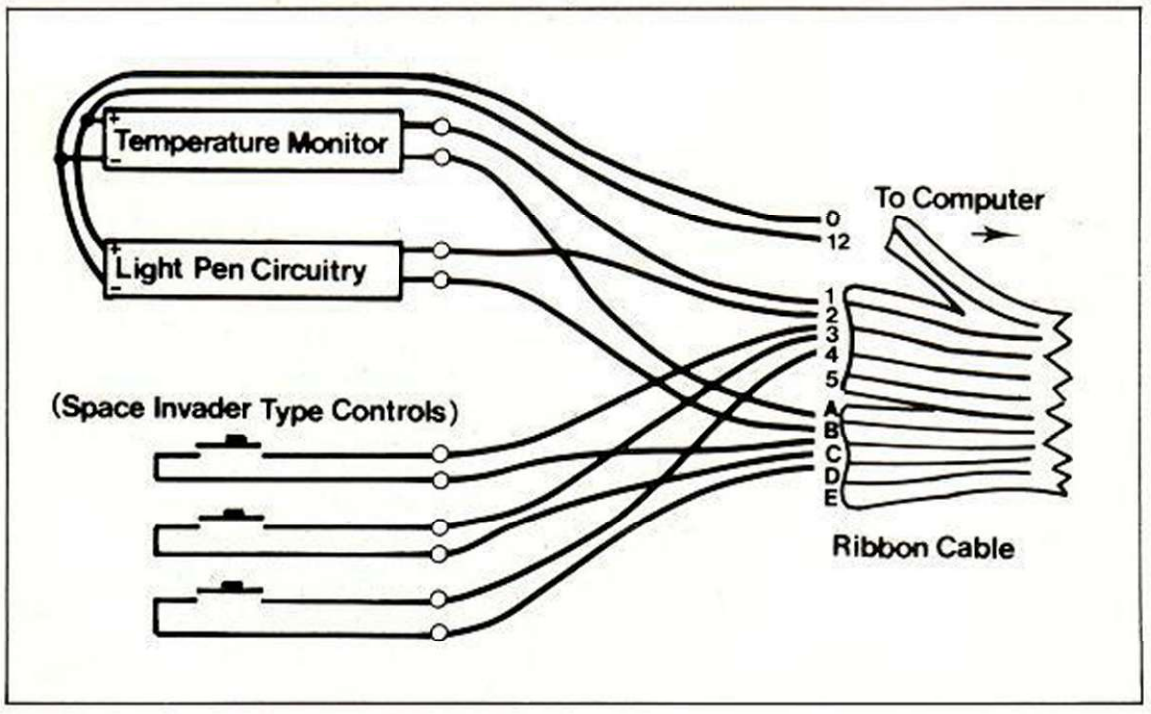


Figure 3.

Veroboard or a home-made board can be used to build the circuits and so the connection at the other end of the cable is entirely at the builder's discretion. My light-pen was built on a board with the photo-resistor in the end of a thick pen. The button is pressed when a reading is required. Software techniques enable signal inversion and screen scanning.

I would advise you to use an external power supply if the machine has any form of memory expansion, as a simple precaution. It is otherwise safe to make the specified connections on a 1K machine. ■



CHROMASONIC electronics

DEPT Y.C., 48 JUNCTION ROAD, ARCHWAY, LONDON N19 5RD

100 yds FROM ARCHWAY STATION & 9 BUS ROUTES

TELEPHONE 01-263 9493 263 9495

YOUR SOUNDEST CONNECTION IN THE WORLD OF COMPUTERS

PET

phone for prices

4016 16K RAM
4032 32K RAM
4040 Dual Drive Disk

The new PET printer.
4022 80 column tracks feed.
3023 80 column friction feed.
C2N Cassette Unit.

For the business man we stock the **8000** range inc. **8032** and **8050** with daisy wheel printers coming soon.

32K SYSTEMS AVAILABLE FROM ONLY £1,499

VIDEO GENIE

Utilises Z80, 12K level II Basic, Integral Cassette Deck. UHF O/P. 16K RAM, all TRS80 features. Simply plugs into monitor or UHF TV. With V.U. Meter. NOW WITH LOWER CASE AS STANDARD **£299**

PARALLEL PRINTER INTERFACE INC. CABLE	£33.00
CHROMASONICS PROGRAMABLE SOUND KIT	£24.94
SOUND KIT (FITTING EXTRA)	£7.00
LOWER CASE KIT (FITTING EXTRA)	£27.50
COLOUR KIT (FITTING EXTRA)	£34.95
EXPANSION BOX WITH/WITHOUT RS232	£215/ 185
16K/32K RAM CARD	£94/ 129
NEW GENIE II NOW AVAILABLE	£320

APPLE

APPLE II PLUS

Apple II plus

48K Machines **£649**
Disk Drive with Controller **£349**
Disc Drive without Controller **£289**
Colour Card **£69**
Graphics Tablet **£425**
Silent type printer **£199**

PRINTERS

EPSON MX80 £359
Dot-matrix printer with Pet graphics interface. Centronics parallel and serial. Pet and Apple compatible. True bidirectional, 80 cps.

EPSON MX80 FT/ 1 £399
Dual single sheet friction and tractor, 9 wire head, true descenders.

INTERFACES AND CABLES
for Apple II, Pet, TRS80, RS232, UK101, Sharp Superboard all available.

EPSON MX80 FT/ 2 £440
An FT/1 with high resolution graphics.

EPSON MX100 £570
Friction and tractor feed, high resolution graphics, wide carriage 15½ inches.

SEIKOSHA GP80A £199
Dot matrix 5 × 7, 80 columns 30 cps. graphics, double width characters.

MONITORS

GREEN MONITOR 9"	£98.00
12" BMC Green	£15
Hitachi professional monitors	
9" Black & White	£99.95
12" Black & White	£149.00

UK101

DOWN IN PRICE

UK 101 Kit **Inc 8K memory**	£125
Ready Built **Inc 8K memory**	£175
Complete in case	£199
4K Expansion 8 × 2114	£10
Printer Interface	£24.50
Sound generator plus PIO kit	£29.95
Chromasonic Sound Kit	£24.50
Colour Kit	£69.95

NEW * NEW * NEW

32K Dynamic Memory Expansion Kit	£89.95
PIO and Eprom programmer kit	£24.50

VIC 20

Colours
24 total. 8 for characters, 8 for border, 16 for screen mixed as you wish. Basic colours on program keys are black, white, red, blue, light blue, green, yellow, and purple.

Sound
3 Tone Generator for music
"White Noise" Generator for language and sound effects.
Each Generator gives 3 octaves.
Reproduction is through TV speaker.

Character/ Line Display
22 Characters by 23 lines
64 ASCII characters, pet-type graphics character set.

Keyboard
DIN typewriter keyboard with 8 programmable function possibilities via 4 special function keys. Colours are directly addressable from the keyboard.

Peripherals/ Accessories
VIC Datacassette with special interface to guarantee high reliability read/write quality (PET/CBM compatible).

PRICE ONLY £165
CASSETTE DECK with 6 free programmes
ONLY £38
Send for list of VIC-20 peripherals

VIC 20

TANTEL

PRESTEL BY TANTEL

COMMUNICATION AT YOUR FINGER TIPS FOR BUSINESS & HOME. UP TO DATE INFO

180,000 pages of information on Travel, News, Investment, Holidays, Hotels Etc., Etc.

only £159

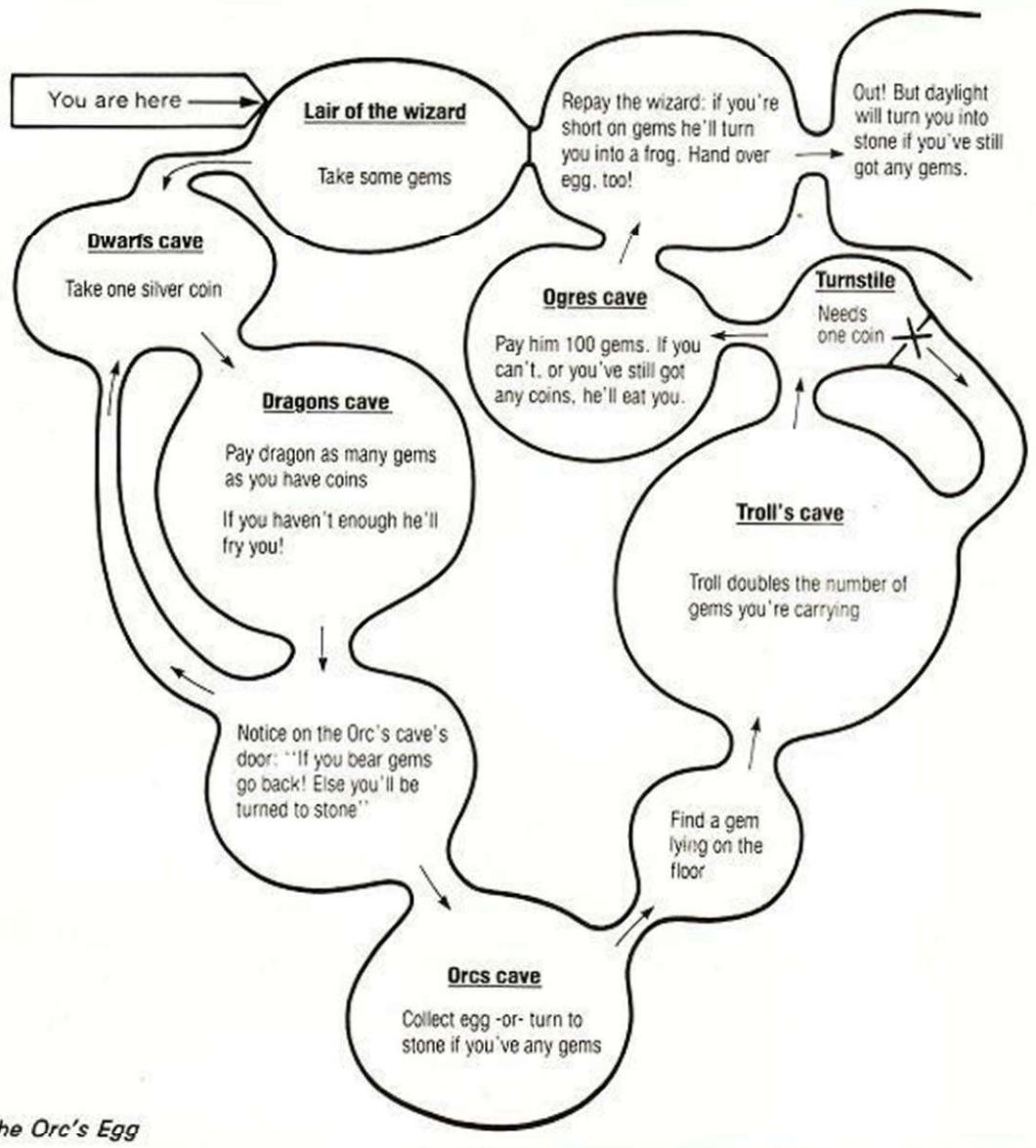
TANTEL IS POST OFFICE APPROVED. SEND FOR DETAILS.
DEMONSTRATION AVAILABLE AT OUR SHOWROOM

ALL ITEMS CARRY A ONE YEAR GUARANTEE

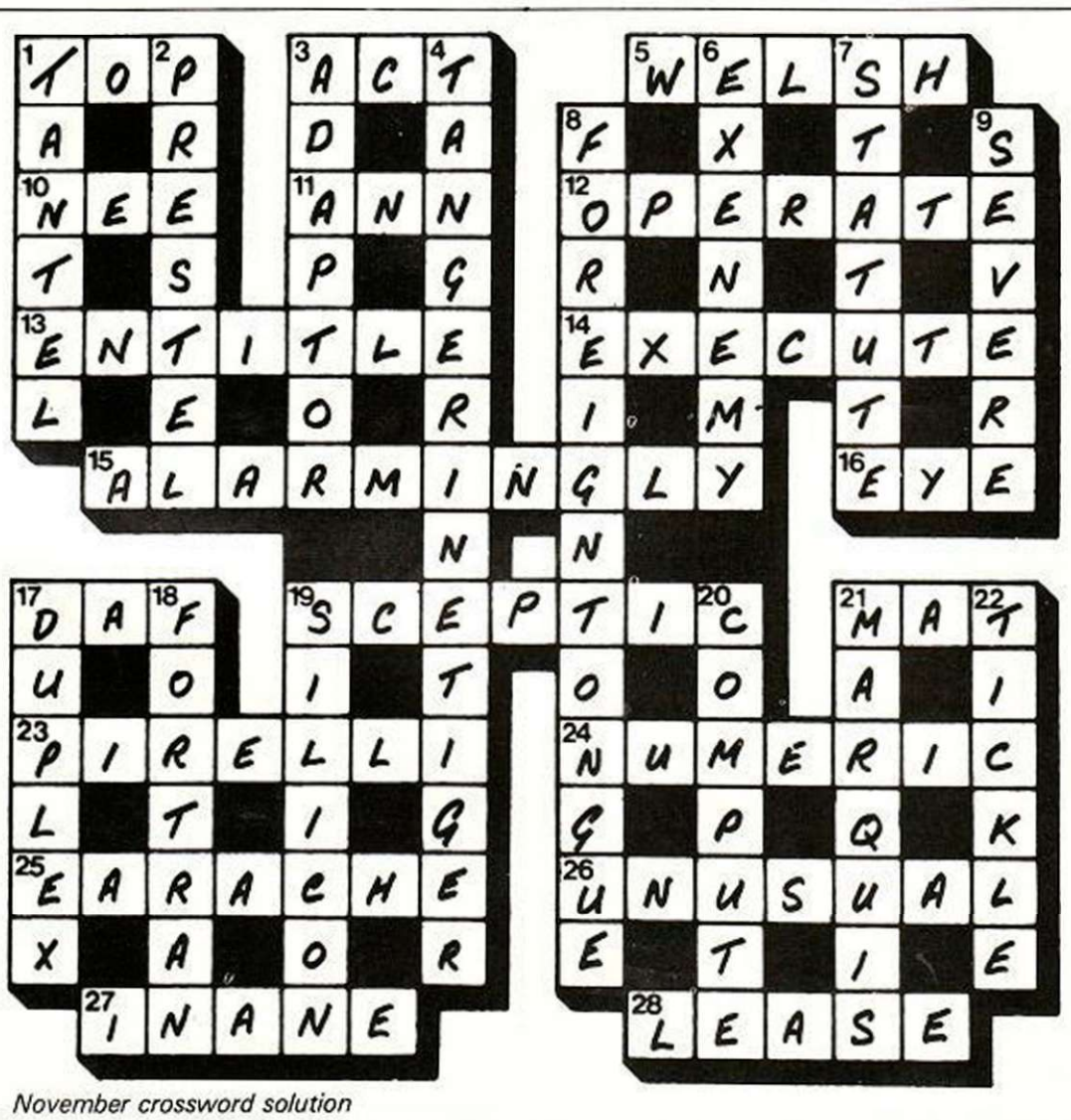
BARCLAYCARD VISA

Please add VAT 15% to all prices. Postage on computers, printers and cassette decks charged at cost, all other items P&P 30p. Place your order using your Access or Barclaycard (Min tel order £5) Trade and export enquiries welcome.

COMPETITION CORNER



The Orc's Egg



November crossword solution

The Orc's Egg

BY ANTHONY ROBERTS

YOU HAVE been captured by the wizard One-Eye who has given you just one chance to avoid an unprintable death: get him the Orc's egg from the Troll's caverns. He can lend you any number of Troll's gems. How many should you take?

Here is the cave map. All the passages are one way.

A £15 book token will be awarded to the first correct solution drawn from the competition bag. All entries must be at the *Your Computer* offices by the last working day in January. The name of the winner, the solution, and a competition report will be published in the March issue of *Your Computer.*

If you want to set a competition for Competition Corner, remember that the simplest solution should be calculable by a short program rather than by any other form of reckoning.

Competition reports

IN THE NOVEMBER Competition Corner puzzle, Trolls' Cave, you are working out a form of Zeller's Congruence, which gives the day of the week of January 1 for any year 1901-2099, at least. Saturday is day 7, Sunday day 1. The formula is

$$\left| \frac{5(YY+1)}{4} + 2 \right|_7$$

so, as you need to be carrying just one diamond as you enter the last cave, you must make your break on a Sunday.

The winner, picked out of a bag with hundreds of correct entries — you obviously all found it too easy — is Peter Evans of 15 Moorland Road, York, YO1 4HF. A £15 book token is on its way to him.

There was a large response to the November crossword competition for a Tantel Adaptor. Most of the solutions sent in were correct, and the ingenuity used in completing the sentence "The most important feature of Prestel is . . ." made the task of choosing a winner extremely difficult. After much deliberation, the adaptor was awarded to I Copestake of 23 Connaught Crescent, Brookwood, Woking, Surrey, GU24 0AN, for his "Prestel lets your fingers do the talking".

British Telecom, and Busby in particular, came in for a fair amount of stick. J Roberts of Hatfield, Hertfordshire summed up the feelings of many people with "to put you in touch with Busby (preferably by the neck!)". An excellent variation on this theme was provided by M Birkett of Hooton, Cheshire, with "two-way communication — now you can give Busby the baud". A Heinrichsons of Wokingham, Berkshire, noted "it's an educational way of increasing the phone bill".

T Brown of Nantwich, Cheshire, had firm views on the intelligence of the family "it is simple enough for the whole family to use it". Other entries worthy of mention include Graham Perry's "that it demonstrates the viability of a non-commuting society" and Jem Ward's "you view the form, then form your view". ■

Microgame Simulations

FREE! tape directory with each tape

ZX81 • Video Genie • TRS80/LII

Battle of Britain As strategic commander of nine British fighter squadrons you must track and intercept the devious enemy bomber squadrons before they reach London. Micro acts as a flight control and communications centre for patrols, missions, intelligence reports etc. Sketch map provided. May also be played on any map of S.E. England with standard grid.

Asset Stripper Compete against your computer controlled arch-rival "KO Investments", capitalizing companies on the stock market and bidding for takeovers to gain control of lucrative assets. Can your micro really outwit you?

Kingdom of Nam As ruler of Nam you must control its economy; allocating labour; building cities, factories and ships; importing and exporting; negotiating pay claims and fighting the looming threats of inflation, strikes, starvation, overpopulation and revolution. How long can you stay in power?

High Stakes Buy, sell, train and bet on racehorses. An opportunity to make money shrewdly and spend it recklessly. Scrolling racing commentary. One or two players.

Party Bran Tub Lots of programs — including one of the best message scrollers around. Play your computer at noughts and crosses and analyse each game afterwards if you wish! Guessing games — words/numbers/rhymes etc. (many <1K)

Also **Invaders** (VG/TRS) and **Wordgram**

All programs in BASIC (for 16K) on quality cassettes.
Send £4.50 for 1/£8 any 2/£11.50:3/£15:4/£18.50:5/£22:6

Please tell us which micro and send cheque/PO to:
73 The Broadway, Grantchester, Cambridge CB3 9NQ

CALCULEX II
ZX 80/81 General Mathematical Program

Adds real power in Advanced Mathematics to your Sinclair computer. Designed for ZX81 (16K) and also for ZX80 (8K ROM). Turns your ZX81 into an effective tool for advanced Algebra, Differential Calculus and Integral Calculus. On the Moving Graph you can **watch** the computer plotting quadratic, cubic and higher equations, finding the roots, solving multiple simultaneous equations. You can **inspect** changing values of the definite integral in Integral Calculus and, at the press of a key, get the differential for any equation (however complicated) in the Differential Calculus. CALCULEX II introduces you to Double Integration, to Harmonic Analysis and the use of Polar Co-ordinates. Tackles equally readily algebraic, trigonometrical and exponential equations of any degree with any number of terms. Solves problems that cannot be solved by standard formulas in algebra or the integral calculus.

The system **can be operated immediately without difficulty by anyone.** It teaches you as you use it, and will give you more understanding of Advanced Mathematics in a week that you could get in a year from traditional teaching.

An essential complement to your ZX81. Of absorbing interest to everyone, young or old, interested in mathematics and wanting to know more. On cassette with full instructions and straightforward guidance on the mathematics.

Send £12 cheque/PO to:
CALCULEX
21 Headland Avenue, Seaford, Sussex.

NEW

ZX81/ZX80 EPROM CARD + FIRMWARE

Enables Useful m/c Programs to be 'on-line' and called from a 2716 EPROM. Increases ZX Functions and Routines. All called using the USR Function.

HARDWARE
Fits neatly between the Computer and RAM. Slight modification needed for ZX80 — details given. EPROM CARD + COMPONENTS.

FIRMWARE ZX81/ZX80 (8K ROM)
Pre-programmed EPROM with:
REN — Fast Renumber Program — all GOTO and GOSUBS correctly renumbered.
SIZE — Size of your Program.
SPACE — Space left free.
HEX-D — Converts Hexadecimal to Decimal.
D-HEX — Decimal to Hexadecimal.
M-FAST — Fast m/c loader.

Price **£17.95** (inc p & p)
ZX EPROM PROGRAMMER *S.A.E. — details.*

ORME ELECTRONICS
2 Barripper Road, Camborne, Cornwall

SILVERSOFT

personal computer software

16K/ZX81 SOFTWARE
"STARTREK" AND NOW "SUPER-WUMPUS"

"16K STAR TREK": Full Graphics, 4-levels of play, 8 × 8 Galaxy, Starbases, Phasors, Photon Torpedos, Klingons, Romulans, Thomans, etc.

"16K SUPER-WUMPUS": Changing Caves, Super Bats, Earthquakes, Pits, Magic Arrows, Traps, etc.

"GAMES PACK 1": Starwars, Hammurabi, Graphic Lander, Mastermind, Minefield.

"GAMES PACK 2": 3D-Oxo, Pontoon, Android-Nim, Flight Simulator.

Prices: £4.95 inc. each cassette
£8.95 any two.

Programs wanted — excellent royalties paid.

Send large s.a.e. for details of our expanding range of software. Mail Order only.

Please quote Ref: YCJ1

SILVERSOFT
40 Empress Avenue
Ilford, Essex
01-518 0877

SPECIAL ANNOUNCEMENT

for all ACORN ATOM owners

PROGRAMMER'S TOOL-BOX

A packed 4K EPROM (fits Utility Socket) containing:

1200 BAUD CASSETTE OPERATING SYSTEM
Visible Load Routine

PLUS	*TRACE(X)	— controlled execution, line no. display
	*STEP	— single step execution
	FIND	— any string of chars. in program
	VAR	— list variables
	LVAR	— print variables
	AUTO X, Y	— automatic line numbering (any start, any step)
	RENUMBER X, Y	— any start, any step
	DELETE X to Y	— any range of line nos.

(*VIA chip required)

HEX Hex and ASCII
1 HEX Hex dump in instruction

PLUS *Additional BASIC statements*

READ, DATA & RESTORE
KEY X — scans keyboard-input to variable
INKEY SX — scans keyboard-input to string variable
IF . . . THEN . . . ELSE
WHILE . . . ENDWHILE
CURSOR X, Y — position cursor as required
ON ERROR
BEEP X, Y — sound a note — any duration, any pitch
ZERO — zeroes all basic variables
POP — close out sub-routine

STOP — Useful de-bugging instructions.

WORKS WITH ANY MEMORY SIZE! GREATLY ENHANCES EXISTING ATOM FACILITIES. DETAILED OPERATING INSTRUCTIONS SUPPLIED.

Real Value at £24.50
+ VAT & 25p P&P
(sae for details & cat.)
(state Atom)

BARCLAYCARD VISA

NASCOM MAGAZINE "MICRO-POWER"

Series articles, club news, letters & answers. Packed full of useful information. Issue 3 NOV. Issue 4 DEC. Back copies available. ORDER NOW TO SECURE YOUR COPIES Only 95p each (incl.)

PROGRAM POWER

5, Wensley Road, Leeds LS7 2LX. Tel. (0532) 683186

Send Sae for details and extensive software cat. (State NASCOM)

PROGRAM POWER

LATEST RELEASES FOR ACORN ATOM

Special Offer
Deduct £1/cassette when ordering 2 or more

QUALITY ATOM PROGRAMS FROM THE LEADING INDEPENDENT SOFTWARE HOUSE

***CHESS** (12K) AT LAST!! M/C code + mode 3 graphics. Look ahead up to 8 moves. Offensive, Normal or Defensive play. 10 sub-levels. Castling. "En Passant" by player. Rejects illegal moves. Take back facility. Action replay with take-over. Set up problem games. only £9.95

MODE 4 VDU (3K + 6K gr) Mix text with mode 4 graphics. 224 chars. incl. upper & lower case. Modify characters. £8.95

MICRO BUDGET Personal Finance (12K) Review & analyse income & expenses. ideal for budgets & cash flow. £8.95

***ASTROBIRDS** (12K) — incredible GALAXIAN type program, with fantastic sound effects! Screaming missiles, swooping birdmen. High score display. £8.95

LUNAR LANDER (12K) superb version of arcade game incl. long & short range scans, limited fuel supply. £8.95

INVADER FORCE (12K) 4 invader types, mother ship, great sound, hi-score, 6 skill levels. Terrific version. £8.95

3D ASTEROIDS (5K + 2K gr) — steer through the rolling, hurtling asteroids. Excellent real life graphics. £6.95

MARTIANS (12K + VIA) — use your force field to stop them landing. Beware the imposters. Needs quick reactions. £7.95

ALIEN MAZE (5K + 2K gr) — escape the 3D labyrinth before the Alien tracks you down. £5.95

HI-STATS (12K + fl.pt) — statistical analysis & graphical rep. of file of input values. Many options. £7.95

DEMON DUNGEON (5K) — find the treasure, the way out & escape the demons. £6.95

DAMBUSTERS (3K + 2K gr) — realistic bombing raids, bouncing bombs, ack-ack etc. £4.95

SUPER RACE-TRACK (12K) — draw your own race-track & race against the clock, steering & accelerator controls. £4.95

EDIT (5K) £6.95 **CONDENSE** (4K) £5.95 **MAZE-BALL** (12K) £4.95
SPACE STORM (4K) £4.95 **REVERSI** (5K + 2K gr) £5.95
Extra **MEMORY** 2 × 2114 Low power chips £3.75

WRITTEN ANY PROGRAMS! — WE PAY 20% ROYALTIES!

Please add 55p/order P&P
+ VAT at 15%.
Send Sae for catalogue.

VISA

PROGRAM POWER
5 Wensley Road,
Leeds LS7 2LX.
Tel (0532) 683186

io systems ltd.

A/D BOARD FOR NASCOM
- 8 input channels
- 30 miscrosec conversion
- Over voltage protection
- Prototyping area
- 8 bit resolution
- Sample and hold
- Full flat/interrupt control
- NASBUS compatible

Price **£135** + 15% VAT (post free)

GRAPHICS BOARD FOR NASCOM
- 384(H) × 256(V) high resolution graphics display
- Fully bit mapped
- Full software control
- Mixed text and graphics
- NASCOM 2 or 4MHz NASCOM 1
- Graphics software supplied

Price **£55** + 15% VAT (post free)

EPROM PROGRAMMER
- Programs 3 rail: 2708/2716
- Single rail: 2508/2758, 2516/2716, 2532/2732
- Software supplied for Read/Program/Verify
- Can be used with other machines with 2 parallel ports

Price **£63** + 15% (post free)

DUNCAN
- Fast real time interpreter/control language for NASCOM 1 or 2 (please specify)

Price **£12** + 15% VAT (post free)

MEMORIES
- 4116-150ns **95p** each + 15% VAT (min order 8)
- 64K-200ns **£10** each + 15% VAT

MONITORS
- BMC 12" green phosphor — 18MHz

Price **£175** × 15% VAT (carriage paid)

6 Laleham Avenue, Mill Hill, London NW7 3HL
Tel: 01-959 0106

ZX-80 & ZX-81

THE FINEST MACHINE CODE FAST MOVING GRAPHICS ARCADE GAMES AVAILABLE

QS-DEFENDERS

UP:DOWN: THRUST:FIRE CONTROLS. FULL SCREEN DISPLAY. 84 fast moving chrs. 10 missiles. Attack waves. Moving surface. Generally considered to be the best arcade type game written for the ZX COMPUTERS. REQUIRES 3K RAM; 8K ROM

QS-ASTEROIDS

LEFT:RIGHT: THRUST:FIRE CONTROLS. 2 sizes of ASTEROIDS. Wrap-around screen. Full mobility of ship. Bonus ship. QUICKSILVA'S latest arcade game. As good as QS-DEFENDER. REQUIRES 4K RAM; 8K ROM + SLOW MODE

Both programs feature on screen scoring and have software to drive QS SOUND BD.

They are recorded twice on High quality cassettes and have FULL COLOUR cassette inserts of original paintings by 'STEINAR LUND'

HARDWARE

QS MOTHER BOARD and QS CONNECTOR
The heart of any expansion system. Features on board 5V regulator + two expansion sockets to take add-on boards. Can be used in two ways.
1) ZX COMPUTER-CONNECTOR-ANY SINGLE ADD-ON (but no extra RAM PACK)
2) ZX COMPUTER-CONNECTOR-MOTHER BD. (for two extra bds).
— ANY RAM PACK

QS 3K RAM BOARD (using 2114 I.C.s)
A 3K static Ram bd to fit ZX-80/81. Combines with original 1K to give 4K

QS SOUND BOARD (using AY-3-8910)
A 3 channel sound effects and music board easily programmed from BASIC

QS CHRS BOARD
A programmable Graphics generator giving user control of 128 different chrs. Comes with Demo cassette of M/C routines for easy use. Works with ZX PRINTER (Demo cassette available separately to make use of Printers graphics possibilities).

NEW HARDWARE

QS HI-RES BOARD (available end of Jan). 256 × 192 PIXELS. SOFTWARE SELECT. 6K ON BOARD RAM. MIXED TEXT & GRAPHICS. RESIDENT HI-RES SOFTWARE IN ROM.

COMMANDS . . . MOVE x,y; PLOT x,y; DRAW x,y; PRINT Xs; COPY; WHITE; BLACK; CLEAR
A MASTERPIECE of ZX design. Resident software in ROM provide extremely fast Hi-res facilities. No tedious cassette loading. No loss of valuable Ram space. Just instant HI-RES GRAPHICS. Screen may COPIED TO the printer.

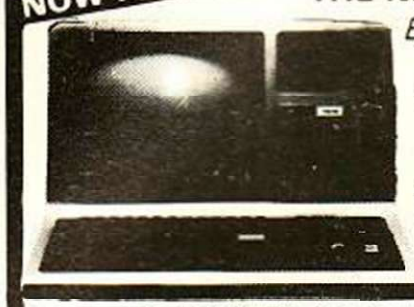
All products fully guaranteed. Fully inclusive prices are as follows:
QS DEFENDER £5.50/QS ASTEROIDS £5.50/QS CHRS DEMO (separately) £3.50
QS MOTHER BD. £12.00/QS CONNECTOR £4.00/QS SOUND BD. £26.00
QS CHRS BD. £26.00/QS 3K RAM £18.00/QS 16K RAM £35.00/QS HI-RES £85.00
Cheques should be made payable to "Quicksilva" and sent to the following address

QUICKSILVA, 95 UPPER BROWNHILL ROAD, MAYBUSH, SOUTHAMPTON, HANTS.

Send S.A.E. for Catalogue and data sheets to above address.
COME AND SEE OUR FULL RANGE AT THE ZX MICROFAIR ON 30TH JAN 1982

NOW IN STOCK

THE NEW & *EXCITING* TRS80 MODEL III



EXTENDED GUARANTEE BY COMPUCARE

48K

£619 + VAT

The Radio Shack TRS-80™ Model III is a ROM-based computer system consisting of:
- A 12-inch screen to display results and other information
- A 65-key console keyboard for inputting programs and data to the Computer
- A Z-80 Microprocessor, the "brains" of the system
- A Real-Time Clock
- Read Only Memory (ROM) containing the Model III BASIC Language (fully compatible with most Model I BASIC programs)
- Random Access Memory (RAM) for storage of programs and data while the Computer is on (amount is expandable from "16K" to "48K", optional extra)
- A Cassette Interface for long-term storage of programs and data (requires a separate cassette recorder, optional/extra)
- A Printer Interface for hard-copy output of programs and data (requires a separate line printer, optional/extra)
- Expansion area for upgrading to a disk-based system (optional/extra)
- Expansion area for an RS-232-C serial communications interface (optional/extra)

All these components are contained in a single moulded case, and all are powered via one power cord.

Disc Drives Kit with 2x40 Track Drives — **£599** + VAT
Disc Drives Kit with 2x80 Track Drives — **£729** + VAT
Add **£25** for Installation

YOUR ZX80 IS NOW NO LONGER REDUNDANT

Upgrade your ZX80 to the full animated graphics of the ZX81. (No screen flicker).

FOR ONLY **£12.95** + VAT IN KIT FORM

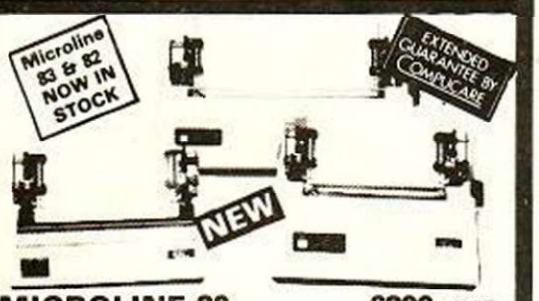
Works only in conjunction with **NEW** 8K ROM from Sinclair (Not Included).

UP GRADE YOUR SINCLAIR TO A 16K RAM PLUS EXPANSION BOARD WITH 3 SLOTS

This Expansion Board is designed for more than just memory - that's why it costs more than others!

16K £69 + VAT **4K £49** + VAT

Microline 83 & 82 NOW IN STOCK



EXTENDED GUARANTEE BY COMPUCARE

NEW

MICROLINE 80 — £299 + VAT

- 80 cps Uni-directional
- Small size: 342 (W) × 254 (D) × 108 (H) mm.
- 160 Characters, 96 ASCII and 64 graphics
- 3 Character sizes: 40, 80 or 132 chars/line
- Friction and Pin Feed
- Low noise: 65 dB
- Low weight: 6.5 kg

MICROLINE 82 — £449 + VAT

- 80 cps Bi-directional logic seeking
- Small size: 360 (W) × 328 (D) × 130 (H) mm.
- 160 characters, 96 ASCII and 64 graphics, with 10 National character-set Variants.
- 4 Character sizes: 40, 66, 80 or 132 chars/line.
- Built-in parallel and serial interfaces.
- Friction and Pin Feed
- Low noise: 65dB
- Low weight: 8kg

MICROLINE 83 — £779 + VAT

- 120 cps bi-directional logic seeking
- 136 column printing on up to 15in forms
- Small size: 512 (W) × 328 (D) × 130 (H) mm.
- 160 characters, 96 ASCII and 64 graphics with 10 National character-set variants
- 3 Character spacings: 5, 10 and 16.5 Chars/in.
- Built-in parallel and serial Interfaces
- Friction and Pin Feed
- Low noise 65dB
- Low weight: 13 kg

STOCKTAKE SALE NEVER TO BE REPEATED AT THIS PRICE UNTIL STOCKS LAST

EUROPE'S FASTEST SELLING ONE BOARD COMPUTER

COMPUKIT UK101

COMPUKIT WITH ALL THE FEATURES THAT MADE IT THE MOST PROFESSIONAL COMPUTER KIT ON THE MARKET. Now WITH FREE NEW MONITOR (a saving), which includes Flashing Cursor, Screen Editing, & Save Data on Tape.

★ 6502 based system — best value for money on the market. ★ Powerful 8K Basic — *Fastest around* ★ *Full Qwerty* Keyboard ★ 1K RAM Expandable to 8K on board. ★ Power supply and RF Modulator on board. ★ No Extras needed — Plug-in and go ★ Kansas City Tape Interface on board. ★ Free Sampler Tape including powerful Dissassembler and Monitor with each Kit. ★ If you want to learn about Micros, but didn't know which machine to buy then this is the machine for you

Build, Understand and Program your own Computer for only a small outlay.

KIT ONLY **£99.95** + VAT

Fully Assembled — **£149** + VAT

4K Upgrade Kit **£15.90** + VAT

NEW MONITOR IN ROM — available separately at **£7.90** + VAT.
Improved Basic function — revised GARBAGE routine. Allows correct use of STRING ARRAYS **£4.90** + VAT
This chip can be sold separately to existing Compukit and Super board users.

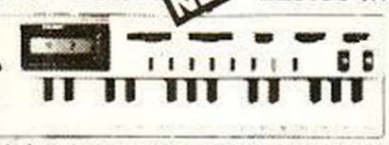
FOR THE COMPUKIT — Assembler Editor **£14.90**

GAME PACKS — 1) Four Games **£5.00** 2) Four Games **£5.00** 3) Three Games 8K only **£5.00**
Super Space Invaders (8K) **£6.50** Chequers **£3.00** Realtime Clock **£3.00**

Case for Compukit **£29.50** 40 pin Expansion Jumper Cable **£8.50** All Prices exclusive VAT

CASIO VL TONE NEW £29.95 VAT

EXTENDED GUARANTEE BY COMPUCARE



It's a new kind of musical instrument. A computer controlled synthesiser that helps you create, play and arrange compositions that normally take years of musical training.

WE ARE NOW STOCKING THE APPLE II AT REDUCED PRICES

AUTOSTART EURO PLUS

EXTENDED GUARANTEE BY COMPUCARE

48K £649 + VAT

Getting Started APPLE II is faster, smaller, and more powerful than its predecessors. And it's more fun to use too because of built-in features like:
- BASIC — The Language that Makes Programming Fun.
- High-Resolution Graphics (in a 54,000-Point Array) for Finely-Detailed Displays.
- Sound Capability that Brings Programs to Life.
- Hand Controls for Games and Other Human-Input Applications.
- Internal Memory Capacity of 48K Bytes of RAM, 12K Bytes of ROM, for Big-System Performance in a Small Package.
- Eight Accessory Expansion Slots to let the System Grow With Your Needs.

You don't need to be an expert to enjoy APPLE II. It is a complete, ready-to-run computer. Just connect it to a video display and start using programs (or writing your own) the first day. You'll find that its tutorial manuals help you make it your own personal problem solver.

NEW

ACORN ATOM

UNIQUE IN CONCEPT — THE HOME COMPUTER THAT GROWS AS YOU DO

Fully Assembled **£149** + VAT

EXTENDED GUARANTEE BY COMPUCARE

Special features include
- Full Sized Keyboard
- Assembler and Basic
- Top Quality Moulded Case
- High Resolution Colour Graphics
- 6502 Microprocessor

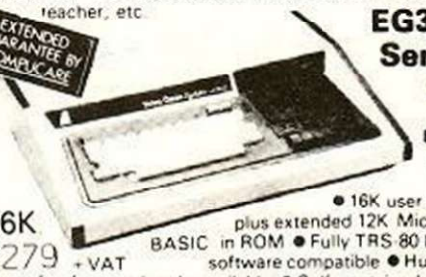
THE VIDEO GENIE SYSTEM

Ideal for small businesses, schools, colleges, homes, etc. Suitable for the experienced, inexperienced, hobbyist, teacher, etc.

EXTENDED GUARANTEE BY COMPUCARE

EG3000 Series

WITH NEW EXTRA KEYS!



16K £279 + VAT

- 16K user RAM plus extended 12K Microsoft BASIC in ROM
- Fully TRS-80 Level II software compatible
- Huge range of software already available
- Self contained, PSU, UHF modulator, and cassette
- Simply plugs into video monitor or UHF TV
- Full expansion to disks and printer
- Absolutely complete — just fit into mains plug.

The Video Genie is a complete computer system, requiring only connection to a domestic 625 line TV set to be fully operational; or if required a video monitor can be connected to provide the best quality display. 51 key typewriter style keyboard, which features a 10 key rollover. Supplied with the following accessories:- ● BASIC demonstration tape; ● Video lead; ● Second cassetee lead; ● Users manual; ● BASIC manual; ● Beginners programming manual. Write useful programs in the BASIC computer language yourself.

HITACHI PROFESSIONAL MONITORS

EXTENDED GUARANTEE BY COMPUCARE

9" — ~~£129~~ **£99.95**
12" — ~~£199~~ **£149**

- **Reliability** Solid state circuitry using an IC and silicon transistors ensures high reliability.
- **500 lines horizontal resolution** Horizontal resolution in excess of 500 lines is achieved in picture center.
- **Stable picture** Even played back pictures of VTR can be displayed without jittering.
- **Looping video input** Video input can be looped through with built-in termination switch.
- **External sync operation** (available as option for U and C types)
- **Compact construction** Two monitors are mountable side by side in a standard 19-inch rack.

EXTENDED GUARANTEE BY COMPUCARE

SHARP PC1211

£79.90 + VAT

COMPUTER POWER THAT ONCE FILLED A ROOM CAN NOW BE CARRIED IN YOUR POCKET!

"Europes Largest Discount Personal Computer Stores"

Delivery is added at cost. Please make cheques and postal orders payable to **COMPSHOP LTD.**, or phone your order quoting **BARCLAYCARD, ACCESS, DINERS CLUB** or **AMERICAN EXPRESS** number.

MAIL ORDER AND SHOP: **CREDIT FACILITIES ARRANGED** — send S.A.E. for application form.
14 Station Road, New Barnet, Hertfordshire, EN5 1QW *(Close to New Barnet BR Station — Moorgate Line).*
Telephone: 01-441 2922 (Sales) 01-449 6596 Telex: 298755 TELCOM G
OPEN (BARNET) — 10am - 7pm — Monday to Saturday

NEW WEST END SHOWROOM:
311 Edgware Road, London W2. Telephone: 01-262 0387
OPEN (LONDON) — 10am - 6pm — Monday to Saturday

TELEPHONE SALES
OPEN 24 hrs. 7 days a week
01-449 6596

- **IRELAND: 19 Herbert Street, Dublin 2. Telephone: Dublin 604155**
- **COMPSHOP USA,** 1348 East Edinger, Santa Ana, California, Zip Code 92705 Telephone: 0101 714 5472526

BARCLAYCARD VISA

MICROAGE ELECTRONICS

* Personal Computers * TV Games
* VCR's * Printers * Monitors * Software

ATOM's and DAI's ALWAYS IN STOCK

Complete range of Atari games.
Open Mon – Sat. 9am till late.
Credit cards welcome.

NEW THIS MONTH

You could collect **£10 OFF**

£5 voucher on goods over £100
£5 voucher when you introduce a new customer
The Seikosta 96 ASCII character printer only £199 inc. VAT.
Paper and cable free.

Send for price list and mail order details.
135 HALE LANE EDGWARE MIDDLESEX HA8 9QP
TEL: 01-959 7119 TELEX 881 3241

TEACHING
Z80-ASSEMBLER MICRO-CONTROLLER

MENTOR

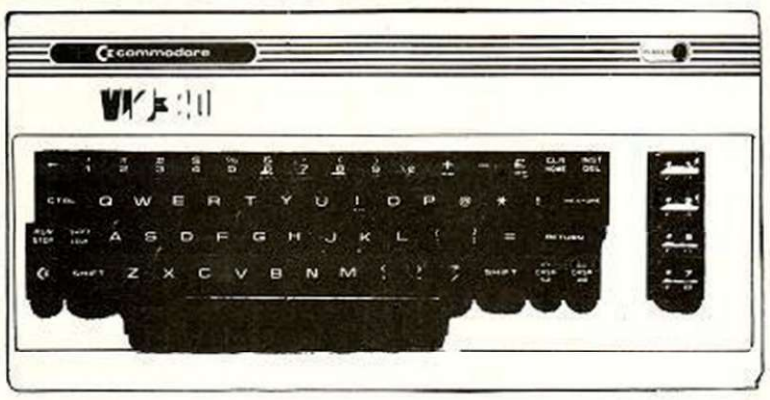
1. MONITOR or TV output (625 line UHF). PROGRAM, STACK and REGISTER contents visible.
2. 40-KEY, 3-LEVEL KEYPAD with Z80 ASSEMBLER MNEMONICS and HEX. PROGRAM-EDIT, STEP, RUN etc.
3. 24 bits of I/O can control external machinery, indicators etc.
4. CASSETTE INTERFACE.
5. BEEPER gives entry and error feedback.
6. LED gives prompt and page number.

MENTOR was designed to fulfil request of Schools Council's Modular Courses in Technology Project for "Microelectronics Teaching Devices" for use in a module which is now being tested in schools in Bromley. Inquiries are invited from Companies and Institutions with commitment to train students in SYSTEM DESIGN. MENTOR is from the same stable as the SOFTY development systems.

*Price is for a SAMPLE UNIT with POWER SUPPLY and TV LEAD. £115 + £17.25 (15% VAT) = £132.25.

DATAMAN DESIGNS,
Lombard House, Dorchester, Dorset DT1 1RX
Dorchester (0305) 68066 (UK sales)
Maiden Newton (0300) 20700 (Export)

VIC 20 Volks Computer. With colour and sound.



£189.95 including v.a.t

TWICKENHAM COMPUTER CENTRE LTD
01-892 7896
01-891 1612

VISA

I WISH TO PAY BY BARCLAYCARD/TRUSTCARD
PLEASE CHARGE TO MY ACCOUNT
MY BARCLAYCARD/TRUSTCARD NUMBER IS

SIGNATURE
NAME
(BLOCK CAPITALS)
ADDRESS

72 Heath Road Twickenham Middlesex

PUT YOUR MICRO TO WORK!

YOUR MACHINE

CONTROL MACHINES, ROBOTS, FACTORY OR HOME

Have you ever wanted your MICRO to control a machine for you, or manage your house? If so, the MDR 'MICROCOMPUTER CONTROL INTERFACE' will give you isolated channels of OUTPUT (8A @ 250 volts) and switch sensing INPUTS.

Available now for connection to PET USER, PORT, RS232 and IEEE488, allowing expansion up to more than 900 channels.

Supplied complete with connecting cables, full data and guarantee from £12.54 per channel. Complete preprogrammed systems or individual components available. Write or phone for details.

M D R (INTERFACES) LTD.
Little Bridge House, Dane Hill,
Nr. Haywards Heath, Sussex RH17 7JD.
Telephone: 0825-790294.

---

apple '82
® 1st National Apple User Convention

Reserve these dates now!

Apple User Convention
– April 24-25

Apple User Exhibition
– April 23-25

It's going to be the biggest Apple event ever held – and a MUST for all Apple users.

From Friday, April 23, to Sunday, April 25, the whole of the ultra-modern Fulcrum Centre in Slough will be completely devoted to the Apple.

And it will be an action-packed weekend. Some of the world's top Apple experts will be revealing their secrets. There will be hands-on demonstrations of Apple programs. Plus a comprehensive exhibition of all the latest Apple hardware and software.

There's bound to be a big demand for Apple '82 – so early booking is advisable.

For details write to: Apple '82, Europa House, 68 Chester Road, Hazel Grove, Stockport SK7 5NY.

B.B.C. ROM SETS NEW COLOUR ENCODER

Write for details to:
THE ACORN SPECIALIST IN YORKSHIRE

Hardware

ACORN Atoms with new keyboard	From £140.00
ACORN GP-80 Printer	£232.00
6522 VIA interface chip	£9.99
74LS244 Buffer	£3.22
Printer socket for ATOM	£3.60
4K Floating point ROM	£23.00
NEW ACORN 100K single disk pack	£348.85
ATOM Word Pack ROM	£30.00
UTILITY ROMS Ext. Basic/Toolchest/Interface	From £30.00
Extra Memory per 1K — Recommended	£3.20
ATOM Power supply	£10.20
ATOMTEL. Converts Atom into Prestel Terminal	£142.00

Software

GAME 1 Asteroids + Subhunt + Breakout	£11.50
GAME 2 Dogfight + Mastermind + Zombie	£11.50
GAME 3 Rat Trap + Lunar Lander + Black Box	£11.50
GAME 4 Star Trek + Four Row + Space Attack	£11.50
GAME 5 Invaders + Wumpus + Reversi	£11.50
GAME 6 Dodgems + Simon + Amoeba	£11.50
GAME 7 Green Things + Ballistics + Snake	£11.50
GAME 8 Stargate + Go Moko + Robots	£11.50
SOFT VDU New Character set Design	£11.50
MATHS Pack 1. Maths Pack 2.	£11.50
ATOM DATABASE Versatile & efficient	£11.50
UTILITY Pack 1. Disassembler + Fast COS + Renumber	£11.50
PEEKO-Processor. Simulates a Micro on the TV screen	£11.50

NEW Software from ACORNSOFT

ATOM Desk Diary. Address Book + Planner	£11.50
GAME 9 Snapper + Minotaur + Babies	£11.50
GAME 10 Ten Games for Minimum ATOM. Breakout + Hectic + Mastermind + Ski-Run + Snake + Track + Simon + Squash + Moon + Bombs	£11.50
ATOM Adventures + Dungeon + House + Intergalactic	£11.50
ATOM Synthesiser. Music notes on a stave. Manual + Play + Record + Edit + Tempo + Save + Load. Dem tunes inc. Bach's Toccata, Fugue, (+ Teddy Bears Picnic for the serious music lover)	£11.50
ATOM Life Package. One of the fastest versions of life	£11.50
ATOM FORTH. Full implementation	£11.50
ATOM FORTH Users Guide	£6.00
ATOM WORD TUTOR. Pairs + Relations + Sentences. Suitable for primary school children	£11.50
ATOM INTRODUCTORY PACK — 4 cassettes 1 Interactive Teaching. Teaches you to talk to ATOM 2 Financial Planning. Minicalc + Sales 3 Household. Phonebook + Learn to touch type + Timer 4 Games. Attack + Connect 4 + Breakout + Memory + Mastermind	£23.00
ATOM CHESS	£11.50
ATOM Business cassette by J Phipps	£8.79

Books

NEW "Practical Programs for the BBC computer and the Acorn Atom" — David Johnson-Davies — Dec 81	£5.95
ATOM Business book by J. Phipps	£6.95
ATOM Magic Book	£5.50
Getting Acquainted with your ACORN ATOM	£7.95

For more information ask to be put on our mailing list

All prices include UK P&P + VAT where applicable

ELTEC SERVICES LIMITED
231 MANNINGHAM LANE, BRADFORD BD8 7HH
TEL: 0274 491372

CASSETTE ONE

PROGRAMS FOR ZX81

"I had your Invaders/React cassette . . . I was delighted with this first cassette."

P. Rubython, London

"Thanks for your Cassette One you sent me — some excellent games at a very cheap price!"

P. Rushton, Leeds

MACHINE CODE	BASIC
REACT	1 CHING
INVADERS	MASTERMIND
PHANTOM ALIENS	BASIC HANGMAN
MAZE OF DEATH	ROBOTS
PLANET LANDER	
BOUNCING LETTERS	
BUG SPLAT	

Ideal if you have a 1K ZX81 because:

- All the ACTION programmes are in machine code
- No-one else sells machine code programs as cheaply
- Quality cassettes (FUJI or TDK) are used
- The sequence of 11 programs is repeated 4 times, just in case a program won't load
- Cassette One is posted First Class
- Side 2 contains large screen versions of INVADERS and MAZE OF DEATH, ready for when you get the 16k RAM pack

Send £3.80 to

Michael Orwin, 26 Brownlow Road, Willesden, London NW10 9QL

P.S. Previous customers who did not get the large screen versions (for 16K) can get free upgrade instructions by sending me a sae.

NORTH EAST

MICROCOMPUTER CENTRE AND ENTHUSIASTS CORNER

BBC MICRO MAINTENANCE
ACORN — VIDEO GENIE — VIC 20 — SWTP ETC
BBC BASIC FOR ATOM

PRINTERS
SEIKOSHA GP80, EPSON, ANADEX, QUME ETC

DISC DRIVES
FOR ALL MICROS
CHIPS — RAM, SUPPORT ETC.

ACCESSORIES
PLUGS, CABLES, ETC.

CONSUMABLES
PAPER CASSETTES AND DISKETTES ETC

MAINTENANCE
FULL SERVICE AVAILABLE

BOOKS
FULL RANGE FOR ALL MICROS
MATHS ROUTINES FOR ATOM
CONTINUING LANE OF MATHS ROUTINES
AVAILABLE NOW: FOURIER ANALYSTS, PLL NOMINAL EQUATIONS, DIFFERENTIAL EQUATIONS. £10 + VAT
ALSO IN DEVELOPMENT FOR OTHER MICROS.

For full details, information & prices contact

HCCS ASSOCIATES
533 DURHAM ROAD LOW FELL
GATESHEAD TYNE & WEAR
(0632) 821924

ZX81 owners

have you seen

The Cambridge Collection

A book of

30 PROGRAMS

For Only **£4.95**

NO MEMORY EXPANSION NEEDED

Each program has been designed to fit into 1K of RAM

TEACH YOURSELF PROGRAMMING

Comprehensive explanations of each listing will teach you many techniques of **ZX81** programming.

HOURS OF AMUSEMENT

With titles such as FORTRESS, BALLOON, and ODD MAN OUT, you could easily become a **ZX81** addict. Plus, entirely new implementations of well-known favourites; LUNAR LANDING, MASTER CODE, ORBITAL INVADERS, and many others.

CASSETTE AVAILABLE TOO!

If you order the book you can also buy the programs on a quality cassette for only £4.95 extra.

Please send me:

copies of the book at **£4.95** each

copies of the book and cassette at **£9.90** pair

Please send your orders with cheques/PO's to:
Richard Francis, Dept.YC A/S
22 Foxhollow, Barhill, Cambridge, CB3 8EP.

ZX81 Workstation...

. . . is a stylish and ergonomic plinth for the ZX81. It raises and tilts the TV to avoid eyestrain, holds the 16KRAM in place and hides the wiring and power supply. This very professional unit costs £15, a built-in power switch is £3, plus postage at £1.50, inc. VAT.

Peter Furlong Products, 125 Catford Hill, London SE6 4PR. Callers by appointment, please. Tel 01690 7799. Visa, Access.

ADVERTISEMENT INDEX

A		**J**	
Abacus Electronics	82	JRS Software	33
Aculab	37	**L**	
Adda Computers	4	Lasky	43, 47
AF Software	33	Linsac	47
Audio Computer	22	Lowe Electronics	2
Automata Ltd	6	**M**	
B		Macronics	75
Bruce D	85	MDR (Interfaces)	33, 81
Buffer Microshop	85	Melbourne House	54
Bug Byte	23	Memotech	7
Burgh Aids	47	Michael Orwin	83
Byte Shop	88	Micro 80	21
C		Microage	80
Calculex	76	Microfair	78
Cambridge Collection	83	Micro Game Simulation	76
Castle Electronics	20	Micro Gen	22
Chromasonic	72	Micro Style	34
Collins Computer	74	Micro Value	8, 9
Compshop	79	Midwich	6
Computer Concepts	60	**N**	
Computer Contact	86	National ZX-81 Users Group	75
Computer Fair	5	**O**	
Computers For All	82	Oasis Software	56
Control Technology	66	Off Records	74
Crofton	78	On-Line Micro Show	46
D		Orme Electronics	76
Dataman	80	**P**	
Deans Electronics	84	Personal Computer Palace	74
Deans of Kensington	6	Phoenix Marketing	86
DKtronics	14	Program Power	77
E		**Q**	
East London Robotics	74	Quicksilva	77
Educational ZX 81 Users' Group	33	**R**	
Educare	84	Raymond Ekam	75
Electron Equipment	33	RD Laboratories	78
Eltek	81	Redditch Computers	68
Essential Software	51	**S**	
Europress & Windfall	81	S Electronics	60
F		Silica Shop	29
Frome Computing	85	Silicon Tricks	66
Fuller Designs	37	Sinclair Research	44, 45, 87
Furlong Products	83	Silversoft	76
G		Stella Software	82
Grey (UK) Software	78	**T**	
H		Tempus	56
Harding A J (Molimerx)	10	Thurnell	68
HCCS	83	Timedata	68
Hewson Consultants	85	Twickenham Computers	80
Hilderbay	60	**V**	
I		Video Software	64
IO Systems	77	**W**	
		Willow Software	86

Make the most of your Sinclair ZX Computer...

Sinclair ZX software on cassette.

£3.95 per cassette.

The unprecedented popularity of the ZX Series of Sinclair Personal Computers has generated a large volume of programs written by users.

Sinclair has undertaken to publish the most elegant of these on pre-recorded cassettes. Each program is carefully vetted for interest and quality, and then grouped with other programs to form a single-subject cassette.

Each cassette costs £3.95 (including VAT and p&p) and comes complete with full instructions.

Although primarily designed for the Sinclair ZX81, many of the cassettes are suitable for running on a Sinclair ZX80 – if fitted with a replacement 8K BASIC ROM.

Some of the more elaborate programs can be run only on a Sinclair ZX Personal Computer augmented by a 16K-byte add-on RAM pack.

This RAM pack and the replacement ROM are described below. And the description of each cassette makes it clear what hardware is required.

8K BASIC ROM

The 8K BASIC ROM used in the ZX81 is available to ZX80 owners as a drop-in replacement chip. With the exception of animated graphics, all the advanced features of the ZX81 are now available on a ZX80 – including the ability to run much of the Sinclair ZX Software.

The ROM chip comes with a new keyboard template, which can be overlaid on the existing keyboard in minutes, and a new operating manual.

16K-BYTE RAM pack

The 16K-byte RAM pack provides 16-times more memory in one complete module. Compatible with the ZX81 *and* the ZX80, it can be used for program storage or as a database.

The RAM pack simply plugs into the existing expansion port on the rear of a Sinclair ZX Personal Computer.

Cassette 1 – Games

For ZX81 (and ZX80 with 8K BASIC ROM)

ORBIT – your space craft's mission is to pick up a very valuable cargo that's in orbit around a star.

SNIPER – you're surrounded by 40 of the enemy. How quickly can you spot and shoot them when they appear?

METEORS – your starship is cruising through space when you meet a meteor storm. How long can you dodge the deadly danger?

LIFE – J. H. Conway's 'Game of Life' has achieved tremendous popularity in the computing world. Study the life, death and evolution patterns of cells.

WOLFPACK – your naval destroyer is on a submarine hunt. The depth charges are armed, but must be fired with precision.

GOLF – what's your handicap? It's a tricky course but you control the strength of your shots.

Cassette 2 – Junior Education: 7-11-year-olds

For ZX81 with 16K RAM pack

CRASH – simple addition – with the added attraction of a car crash if you get it wrong.

MULTIPLY – long multiplication with five levels of difficulty. If the answer's wrong – the solution is explained.

TRAIN – multiplication tests against the computer. The winner's train reaches the station first.

FRACTIONS – fractions explained at three levels of difficulty. A ten-question test completes the program.

ADDSUB – addition and subtraction with three levels of difficulty. Again, wrong answers are followed by an explanation.

DIVISION – with five levels of difficulty. Mistakes are explained graphically, and a running score is displayed.

SPELLING – up to 500 words over five levels of difficulty. You can even change the words yourself.

Cassette 3 – Business and Household

For ZX81 (and ZX80 with 8K BASIC ROM) with 16K RAM pack

TELEPHONE – set up your own computerised telephone directory and address book. Changes, additions and deletions of up to 50 entries are easy.

NOTE PAD – a powerful, easy-to-run system for storing and retrieving everyday information. Use it as a diary, a catalogue, a reminder system, or a directory.

BANK ACCOUNT – a sophisticated financial recording system with comprehensive documentation. Use it at home to keep track of 'where the money goes,' and at work for expenses, departmental budgets, etc.

Cassette 4 – Games

For ZX81 (and ZX80 with 8K BASIC ROM) and 16K RAM pack

LUNAR LANDING – bring the lunar module down from orbit to a soft landing. You control attitude and orbital direction – but watch the fuel gauge! The screen displays your flight status – digitally and graphically.

TWENTYONE – a dice version of Blackjack.

COMBAT – you're on a suicide space mission. You have only 12 missiles but the aliens have unlimited strength. Can you take 12 of them with you?

SUBSTRIKE – on patrol, your frigate detects a pack of 10 enemy subs. Can you depth-charge them before they torpedo you?

CODEBREAKER – the computer thinks of a 4-digit number which you have to guess in up to 10 tries. The logical approach is best!

MAYDAY – in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

Cassette 5 – Junior Education: 9-11-year-olds

For ZX81 (and ZX80 with 8K BASIC ROM)

MATHS – tests arithmetic with three levels of difficulty, and gives your score out of 10.

BALANCE – tests understanding of levers/fulcrum theory with a series of graphic examples.

VOLUMES – 'yes' or 'no' answers from the computer to a series of cube volume calculations.

AVERAGES – what's the average height of your class? The average shoe size of your family? The average pocket money of your friends? The computer plots a bar chart, and distinguishes MEAN from MEDIAN.

BASES – convert from decimal (base 10) to other bases of your choice in the range 2 to 9.

TEMP – Volumes, temperatures – and their combinations.

How to order

Simply use the order form below, and either enclose a cheque or give us the number of your Access, Barclaycard or Trustcard account. Please allow 28 days for delivery. 14-day money-back option.

sinclair

ZX SOFTWARE

Sinclair Research Ltd, 6 Kings Parade, Cambridge, Cambs., CB2 1SN. Tel: 0276 66104.

To: Sinclair Research, FREEPOST 7, Cambridge, CB2 1YY *Please print*

Please send me the items I have indicated below.

Qty	Code	Item	Item price	Total
	21	Cassette 1 – Games	£3.95	
	22	Cassette 2 – Junior Education	£3.95	
	23	Cassette 3 – Business and Household	£3.95	
	24	Cassette 4 – Games	£3.95	
	25	Cassette 5 – Junior Education	£3.95	
	17	*8K BASIC ROM for ZX80	£19.95	
	18	*16K RAM pack for ZX81 and ZX80	£49.95	
		*Post and packing (if applicable)	£2.95	
			Total £	

*Please add £2.95 to total order value **only** if ordering ROM and/or RAM.

I enclose a cheque/PO to Sinclair Research Ltd for £_____

Please charge my Access*/Barclaycard/Trustcard no.

Please delete as applicable.

Name: Mr/Mrs/Miss _____

Address: _____

YOC 01

VIC 20

See it here, buy it now

AT YOUR LOCAL BRANCH TODAY!

SPECIAL FREE OFFER
FOR EVERY VIC 20 PURCHASED BEFORE THE END OF OCTOBER

Birmingham Byteshop Computerland 94/96 Hurst St, B5 4TD **Tel:** 021 622 7149 **London** Byteshop Computerland 324 Euston Road London W1 **Tel:** 01-387 0505 **Nottingham** Byteshop Computerland 92A Upper Parliament St NG1 6LF **Tel:** 0602 40576 **Manchester** Byteshop Computerland 11 Gateway House Piccadilly Station Approach **Tel:** 061 236 4737 **Glasgow** Byteshop Computerland Magnet House 61 Waterloo St, G2 7BP **Tel:** 041 221 7409

A member of the Comart Group of Companies.