60p

YOUR COMPUTER

MARCH 1982

Vol.2 No.3

We test ZX-81 memory packs

Reviews:
Nascom
Chess machines

Genie plotting
ZX-81 music
Behind the scenes at the BBC

Win £100 of Vic software

RSONAL CO

LONELY Genie I Microcomputer, early eighties, with large peripheral family but currently unattached, would like to meet interesting, attractively packaged software, Genie or Tandy specification, for programming, problem solving, entertainment and long-lasting friendship. Reply in confidence. Box No RS232.

ANSWERING MACHINES

Office certified

ingenious ...but lonely!

Buying your first Genie I microcomputer is just the start of a long and enthralling adventure, for it won't be long before you will want to expand your system with some of the wide range of peripherals which make up the complete Genie System.

Firstly there is the **Expansion Box,** which immediately expands your Genie's capacity to 32K RAM, and up to 48K RAM if required. It can be connected to 4 disk drives, a printer, RS232 interface or S100 cards.

Then there is the **Printer,** a compact unit with 80 column, 5 x 7 matrix print-out, which connects to your Genie through the Expander, or via the Parallel Printer Interface.

The **Disk Drive** gives you greater storage capacity and full random access file handling, with the option of double-density through a special adapter.
New Dual Disk Drive now available!

Finally, there is Genie's very own **12" Monitor,** a must if you want to let the rest of the family watch their T.V. in peace!
Available in B & W or green tube.

The supreme advantage of the Genie I system is its compatibility with the TRS 80, which means that literally 1000's of pre-recorded programs are already available, just waiting to be plugged into your Genie!

The recent improvements in the Genie system, including Extended Basic, sound unit and machine language monitor, make it the ideal system for the committed hobbyist, and an excellent and easy-to-use educational tool.

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!

Please send me FREE, 16 page colour brochure on the Genie Computer System. I enclose 25p postage.

Name _____

Address _____

_____

Telephone _____ YC·82

LOWE electronics

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

YOUR COMPUTER

YOUR LETTERS: 11
ZX-81 animation; speedy Vic; BBC service.

NEWS: 12
World-champion chess machine; creative graphics; new Commodore machines.

COMPUTER CLUB: 15
We visit the Educational ZX-81 Users' Group in Birmingham and talk to its founder, Eric Deeson.

ZX MEMORY PACKS: 16
Stephen Adams tests the range of ZX-81 memory packs and tries to decide which is the most useful and which represents the best value for money.

NASCOM REVIEW: 20
The Nascom microcomputers, produced by Lucas Logic, and a selection of Nascom peripherals and software are reviewed by Malcolm Bell.

INTERVIEW: 24
Brendon Gore talks to Paul Kriwaczek, producer of the BBC's *Computer Programme*, about the work which went into planning the series.

CHESS: 26
A review by John White of the Sci-Sys Chess Champion Mk V — the world champion — and a choice of other chess computers and programs.

GAME: 30
Maze attack — a game for the Pet by Marcus Altman.

ZX-81 MUSIC: 34
A program devised by John Sylvester which allows the ZX-81 to play notes covering an eight-octave range.

SNAKES AND LADDERS: 37
A game of skill and luck, for the ZX-81, by Brian Horsfield.

PLOTTING ON A GENIE: 41
The teaching of graphical methods using polar co-ordinates tends to be neglected in schools, argues Bev Mason. He uses this program, for the Video Genie, to show how to plot graphs on the computer screen.

VIC-20 COMMUNICATIONS: 44
Nick Hampshire explains the intricacies of the Vic-20's RS-232 communications port.

ATOM PROGRAMMING: 51
Boris Allan explains more of the thinking behind how to write an unbeatable noughts and crosses program for the Atom, and presents his solution.

COMPUTER CONTROL: 56
John Dawson looks at a version of Forth which has been introduced for the Tangerine Microtan.

RESPONSE FRAME: 59
More answers to your technical queries.

FINGERTIPS: 61
David Pringle reviews Casio's new mini-printer and offers more calculator programs.

SOFTWARE FILE: 65
Eight pages of your programs, including Vic-20, ZX-81, Atom and others.

COMPETITION CORNER: 75
Another puzzle with a £15 book token as prize. The £100 of Vic Software crossword falls between pages 14 and 15.

Cover photograph by Stephen Oliver.

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 3144

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.

©IPC Business Press Ltd 1982

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

EDITORIAL

THIS IS THE FIRST anniversary of the ZX-81. In the year since it was launched more than 250,000 of them have been bought and somewhat more than half of those have stayed in Britain. Sinclair Research has been subject to a certain amount of criticism, mainly for poor quality control and customer relations, but no one can deny that the company has done computing a great service. The 250,000 who have bought ZX-81s would have had to wait for a long time for another manufacturer to match the Sinclair price.

The anniversary of the launch of the ZX-81 falls in the same month that the BBC has announced it has had to raise the price of the BBC Microcomputer to £299 for the basic model. The £299 might still represent good value for money, but for the ZX-81 user looking for a new computer it is probably too great a jump from the £69.95 price of his first machine.

There are plenty of other companies ready to fill the gap. The most notable of these is Commodore with the Vic-20 at £189.95. It is not a particularly spectacular machine, but the price is right and it does offer most of the things a home user needs — a good Basic, colour, sound and the ability to take plug-in games and program packs, to save the recurring problem of loading from cassette.

In our view it would be a shame if Sinclair were to succumb to the same set-backs suffered by his forays into the pocket-calculator and digital-watch markets. In both cases he was the first on the market and proved that a massive demand existed for the new and untried products he had created. Within a matter of months he was knocked out of the market by superior American and Japanese technology.

If, by the end of this year, it turns out that all Sinclair has managed to do is prime the U.K. market for U.S. and Japanese home computers it would, in retrospect, look as though Sinclair has been less of a help to an otherwise beleaguered Britain than we had at first imagined. We do not want to appear too chauvinistic, and we believe strongly in the merits of free trade, but that does not mean we should be too casual about our own interests.

When *Your Computer* interviewed Clive Sinclair in August 1981, he said, when talking about his experiences with pocket calculators and digital watches, that he did not intend to make the same mistake again. There have, in recent months, been many rumours that a ZX-82 is on its way.

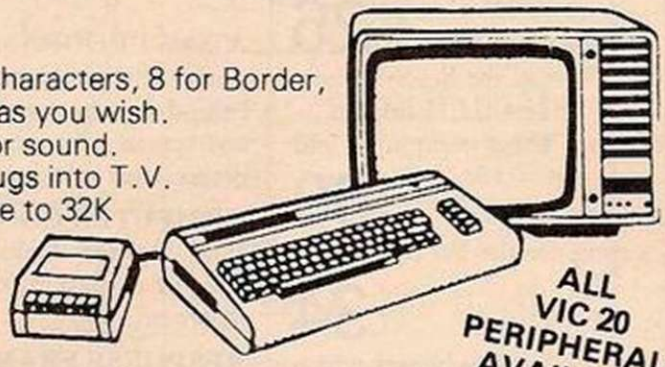
Let us hope firstly that Clive Sinclair does launch a ZX-82 and secondly, that when he does it is not a replacement for the ZX-81, as the ZX-81 was for the ZX-80, but that he has carefully designed his new computer to fill the gaping hole between the ZX-81 and the BBC Microcomputer. Then ZX-81 users, and all the ZX-81 support companies which have sprung up in the last year, will have something to look forward to. ■

CHROMASONIC electronics

48 JUNCTION ROAD, ARCHWAY LONDON N19 5RD 100 yds FROM ARCHWAY STATION & 9 BUS ROUTES
TELEPHONE: 01-263 9493/01-263 9495 TELEX: 22568.

YOUR SOUNDEST CONNECTION IN THE WORLD OF COMPUTERS

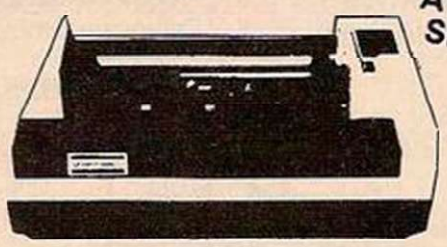
VIC 20



* 24 Colours, 8 for Characters, 8 for Border, 16 for screen mixed as you wish.
*3 tone Generator for sound.
*Uses Pet Basic *Plugs into T.V.
*Memory expandable to 32K
*VIC complete with T.V. Modulator and Power Supply
ONLY £165.00

VIC Cassette Deck
ONLY £38.00

Available soon
VIC Dot Matrix Printer
80 Column, 30 CPS, Tractor Feed
ONLY £199.95



ALL VIC 20 PERIPHERALS AVAILABLE SEND FOR LIST

UK101

DOWN IN PRICE

UK101 Kit **inc 8K memory**	**£125**
Ready Built **inc 8K memory**	**£175**
Complete in case	**£199**
4K Expansion 8x2114	**£10**
Parallel Printer Interface	**£24.50**
Cases	**£19.95**
Chromasonics Sound Kit	**£24.50**
Colour Kit	**£69.95**

NEW NEW NEW

32K Dynamic Memory Board only	**£89.95**
P.I.O. and Eprom Programmer Kit only	**£24.50**

APPLE II PLUS

AUTOSTART "EUROPLUS"
48K Apple Computer **649.00**
Disc Drive with Controller **349.00**
Disc Drive without Controller **299.00**
Colour Card **69.00**
Silentype Printer **199.00**
Graphics Tablet **425.00**
TV Modulator **14.00**

A range of Apple Accessories and Software are available

PET

4016 16K RAM	**445.00**
4032 32K RAM	**569.00**
8032 32K RAM	**755.00**
8096 96K RAM	**960.00**
4040 Disk Drive	**585.00**
8050 Disk Drive	**755.00**
4022 Printer 80 Col	**357.00**
8024 Printer 132 Col	**975.00**
8026 Printer/Typewriter	**835.00**
8027 Daisy Wheel	**735.00**

A range of Pet Accessories and Software are available

PRINTERS

INTERFACES AND CABLES FOR APPLE II, PET, TRS80, RS232, UK101, SHARP SUPERBOARD — ALL AVAILABLE.

EPSON MX80 £359
Dot-matrix printer with Pet graphics interface. Centronics parallel and serial. Pet and Apple compatible. True bidirectional, 80 cps.

EP80 MX82 £389
As MX80 plus high Resolution Graphics

EPSON MX80 FT/1 £399
Dual single sheet friction and tractor feed, 9 wire head, true descenders.

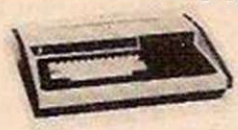
EPSON-MX80 FT/2 £440
An FT/1 with high resolution graphics.

SEIKOSHA GP80A £199
Dot matrix 5 x 7, 80 columns, 30 cps graphics, double width characters.

JUST PHONE FOR FURTHER DETAILS

VIDEO GENIE

£299 EG3003



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.

PARALLEL PRINTER INTERFACE INC CABLE	**£38.00**
CHROMASONICS **PROGRAMMABLE** SOUND KIT	**£24.50**
SOUND KIT (FITTING EXTRA)	**£8.20**
LOWER CASE KIT (FITTING EXTRA)	**£29.80**
COLOUR KIT (FITTING EXTRA)	**£36.00**
EXPANSION BOX INC 16K RAM	**£199**
16K/32K RAM BOARD	**£94/ £129**
NEW GENIE II NOW AVAILABLE	**£310**

MONITORS

9" Green Screen	**£99.00**	HITACHI PROFESSIONAL	
12" Green Screen	**£125.00**	9"	**£99.95**
12" BMC Green Screen	**£159.00**	12"	**£149.00**

TANTEL

PRESTEL BY TANTEL

COMMUNICATIONS AT YOUR FINGERTIPS FOR BUSINESS & HOME. UP TO DATE INFO

180,000 pages of information on Travel, News, Investment, Holidays, Hotels Etc., Etc.

£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 30. Place your order using your Access or Barclaycard (Min. tel. order £10). Export enquiries welcome. Official orders welcome.

We are only 30 minutes from CENTRAL LONDON

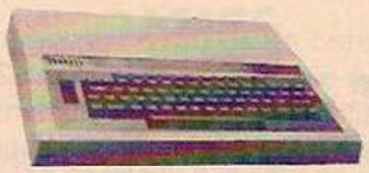
and only a few minutes from Your Postbox

Why not try our new Mail Order Service?

ACORN ATOM

Assembled from £155.25 (While stocks last)

BBC MICROCOMPUTER



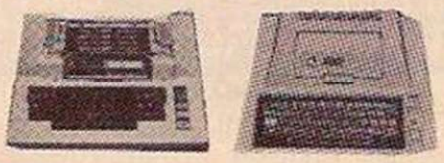
For details of availability Phone 0708-60725

WE ARE DEALERS FOR ACORNSOFT, ADVENTURE INTERNATIONAL, ATARI, AUDIOGENIC, AVALON HILL, BUG BYTE, COMMODORE, PROGRAM POWER & THORN/ EMI SOFTWARE.

VIC-20

£199.99

ATARI 400 & 800



From £299.95 & £599.95

STOP PRESS: NOW IN STOCK
THE BBC PUBLICATION "THE COMPUTER BOOK" £6.75

All prices include V.A.T. Add £3.00 P&P per order
For further information send large S.A.E.

Computers for All

BARCLAYCARD VISA

72 North Street, Romford, Essex. Tel: 0708 60725

NEW

ZX81 (16K)
STOCKS and SHARE PORTFOLIO PROGRAM

IF you would like to make money on the Stock Exchange

IF you wish to have a complete record of your share holdings

THEN
YOU NEED THE SMC
SHARE PROGRAM

The sophisticated menu driven program with comprehensive historical record up to 20 shares. Add/delete facility and graphic presentation. As approved by a member of the accountancy profession.

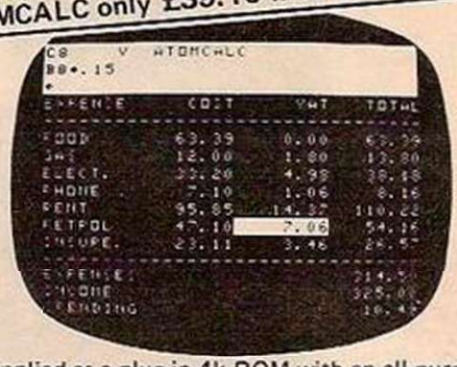
CASSETTE £4.95 (inc. P&P)
(WITH FULL INSTRUCTIONS)

Cheques/PO's to:

M. A. SMITH
2 SOLWAY RISE, DRONFIELD WOODHOUSE,
SHEFFIELD S18 5ZR

Use Your Atom for~

Planning .... Projecting .... Writing .... Estimating ....
Scheduling .... Calculating .... Recalculating .... Erasing ....
Revising .... Critical Path Analysis....
With ATOMCALC only **£39.10 inc. VAT**



What is it?
Atomcalc is supplied as a plug-in 4k ROM with an all-purpose planning and modelling program. It is so easy to use - if you can use a calculator you can use Atomcalc. No programming skill needed.

The ROM creates an enormous grid of columns and rows like a ledger. All you do is to enter the headings and formula once and Atomcalc does the rest. Supplied with a very detailed 30pp user handbook.

What will it do?
Atomcalc can cope with anything from a household budget to company accounts. You set up a series of automatic calculating functions like totalling or percentages. Then fill in the columns with your figures and the program produces the answers. If you want to change one figure in the calculation it immediately changes the relationship of all the other figures involved. So, for example, you can see what effect on profit a 5% increase in sales might have or a 10% increase in production, or a 3% drop in transport.

And do not forget you can print them out on an optional printer or store them on tape.

How Can I Buy One?
Go to your Atom Dealer, or if there are none in your area just send a cheque for £39.10(incl. VAT and P & P) to the address below. Credit Card holders can ring Cambridge (0223) 316039 and order direct.

Dept. Acornsoft Ltd, 4a Market Hill, CAMBRIDGE.

ACORNSOFT TAKE GAMES SERIOUSLY

avo

APPLE PROGRAMS

DARK FOREST *NEW!*
The age was dark, the forest was dark and the Guards were everywhere . . . 48K Disk for Apple II. Normally £19.00. **AVO INTRODUCTORY PRICE £17.00**

HADRON *NEW!*
A 3-D battle in the midst of a meteor field. 48K Disk for Apple II.
Normally £22.00. **AVO INTRODUCTORY PRICE £20.00**

THRESHOLD *NEW!*
An arcade game with alien attackers galore. In fact more monsters are there than we expect you'll ever see. You won't get bored with this one. 48K Disk for Apple II.
Normally £25.00. **AVO INTRODUCTORY PRICE £22.50**

SNACK ATTACK (Pac-Man) *NEW!*
This game has been designed to deliver all the fun and challenge of a major game ... whilst making it almost impossible to stop playing. Anyone who can play just one game deserves a medal for self control. 48K Disk for Apple II.
Normally £19.00. **AVO INTRODUCTORY PRICE £17.00**

THIEF *NEW!*
It's you against rampaging robots. Seven levels of action and excitement to become the galaxy's master thief. As you fight the robots you'll enjoy the speed, the challenge and the hour after hour fun. 48K Disk for Apple II.
Normally £19.00. **AVO INTRODUCTORY PRICE £17.00**

BEER RUN *NEW!*
Catch the Artesians before the Guzzlers and Bouncers catch you !!! 48K Disk for Apple II. Normally £22.00. **AVO INTRODUCTORY PRICE £20.00**

Audio Video Offers, FREEPOST, HODDESDON, Herts, EN11 8BR.
Allow up to 28 days for delivery. All prices include VAT and p.&p.

Please send me as soon as possible the following:

1._____ £____
2._____ £____
I enclose a Cheque/P.O. for the total £____

NAME_____
ADDRESS_____
_____ POSTCODE____

A.P.E. SOFTWARE

PROUDLY PRESENTS
THE 1st EVER ADULTS ONLY CONCEPT ALBUM
FOR THE UNEXPANDED ZX81
THE ADVENTURES OF

GERONIMO PRATT !

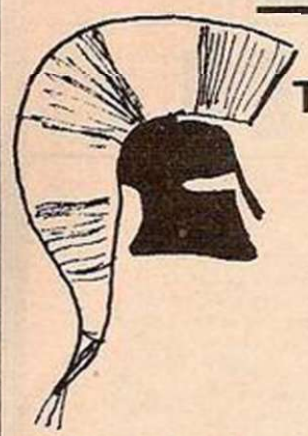
GIGGLE	as we introduce our HERO and his faithful Canine Companion BRUCE.
GASP	as G.P. Drives Uncle Clive's New Porche.
LAUGH	as BRUCE gets his.
SQUIRM	as G.P. falls 'Foul' of a FOUL SEAGULL.
HORROR	as G.P. falls into the hands of the SPANISH INQUISITION and has to save his Manhood.
SHOCK	at the wanton BLOODLUST as GP goes on the rampage.
THRILL	as G.P. becomes a HUMAN CANNONBALL.
SIGH	as G.P. finds his TRUE LOVE.

Rush your crossed cheque or P.O. for £3.50 (inc P &P) (Made payable to M.D. Shields)

A.P.E. SOFTWARE **390/392 Holcombe Road**
Helmshore, Rossendale, Lancs. BB4 4NF
Tel: Rossendale 220596

Warning: Although it is unlikely, some of these adult programs may give offence.

ZX81



TYRANT OF ATHENS

— a brand new 16K game from **M.C. Associates** (specialists in war games and simulations in the Ancient period)

- You are beset by hostile Greek city states as well as being threatened by the vast Persian Empire.
- **Your Aim** — to make Athens the most feared state in the Mediterranean.
- Train and equip troops, build and fit out warships.
- Make allies.
- Fight battles by land and sea.
- Many more features in this exciting new game from M.C. Associates.

Cheque or P.O. please for £4.95 made payable to:

M.C. Associates
4 Granby Road, Cheadle Hulme
Cheshire SK8 6LS

ATOMIC MACHINE CODE

A new book for the Atom owner containing
20+ fully explained machine code programmes

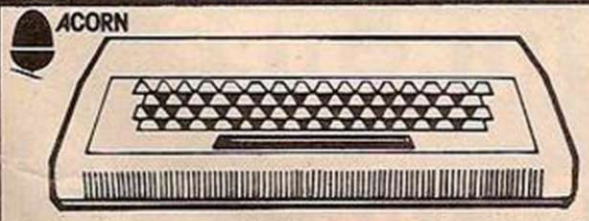
DATA SORTS
DATA STORAGE
KEY SCANS
MODE 4 CHARACTERS
DESIGN LETTERS
PONTOON
POOLS PREDICTION
GAMES
FULL M/C DETAILS
ROM SUBROUTINES

Available early March £4·75 inc. P+P

Ecce Productions · 4a Nelson Road
Greenwich SE10 9JB

ATOMIC MACHINE CODE

MICROAGE ELECTRONICS
LONDON'S BIGGEST ACORN STOCKIST



OFFICIAL BBC STOCKIST

ATOM KITS
In our books the best computer kit available. Build yourself an Acorn Atom for **only £135.**

ATOM SOFTWARE
Games Packs 1–8, Database, FORTH, Atomcalc, everything in stock.

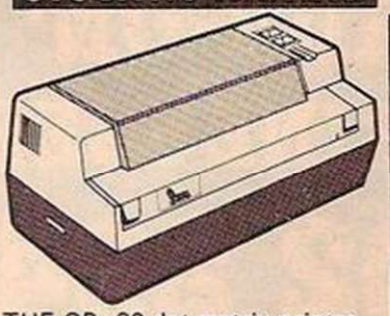
BBC ROM
Update your Atom to the BBC operating system.

Atom Discpack. £345
5¼ discpack only £345, operating manual, cables.

DAI Personal Computer. £684
48K RAM 24K ROM

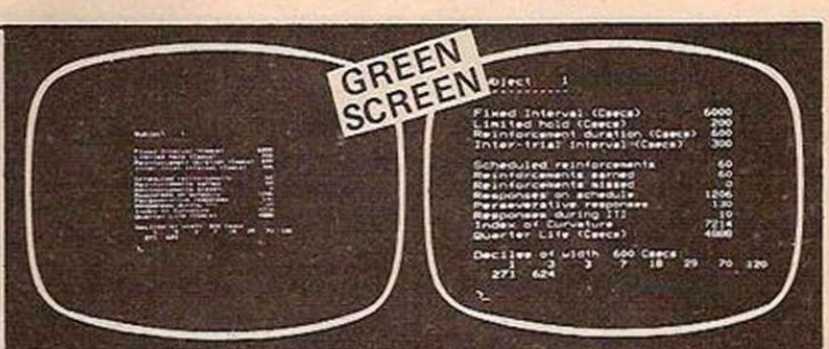
The BBC Cassette Recorder £24
As chosen by the BBC, but cheaper! DIN Control Motor, leads.
If it's not in the advertisement, send for our mail order lists.

EVERYTHING IN STOCK NO WAITING



THE GP–80 dot matrix printer.
LOWEST EVER PRICE
ONLY £199
Dot Matrix, Full 96 ASC11 character

ZX81 Owners £20 off
Bring us your working ZX80 or 81 and get £20 off any Atom — kit or built.



FROM THIS —— TO THIS AT THE FLICK OF A SWITCH

With the new ZENITH Monitor. Choose between small or large format depending on what you're doing. Small format for definition, large format for display. Full 12" GREEN screen. Only £104.95. It doesn't change the output from your computer, just changes the size of the display.

Blank Cassettes 40p each, £3.50 for 10.

Also available:
2114 IC's, Paper for most printers, Enormous selection of Books, Leads, etc, etc, etc,

ATARI VIDEO SYSTEM GAMES
Warlords ——— £19.95
Missile Command ——— £22.50
plus many, many more

ACTIVISION GAMES
Skiing ——— £18.95
Kaboom! ——— £18.95
plus many, many more

ALL PRICES INCLUDE VAT
ABSOLUTELY NO MORE TO PAY.

MICROAGE ELECTRONICS
135 HALE LANE EDGWARE MIDDLESEX HA8 9QP
TEL: 01-959 7119 TELEX 881 3241

a must for your ZX81

Authors:
Ian Stewart & Robin Jones

The reader-friendly guide to getting started with the Sinclair ZX81. Includes an introduction to looping and branching, graphics, subroutines, and debugging techniques, with over 50 programs designed to run on the standard 1K memory.

110 pages — Paperback £4.95 ISBN 0 906812 17 8

Published by: Shiva Publishing Ltd. 4, Church Lane, Nantwich, Cheshire CW5 5RQ. Telephone: (0270) 628272

Order from your bookseller or fill in the coupon

Please supply me with ..... copy/copies of PEEK,POKE,BYTE & RAM. For 1st Class Postage please add 25p
Price: £4.95 per copy. Cheques payable to Shiva Publishing Ltd.

NAME (Capitals please)_____

Full Postal address _____

_____

For payment by Access/American Express

Card No._____ Signature_____

Ctech Software
Simply Megabytes Ahead!

ATOM NEW

DEFENDER: You defend the planet against UFO's, fast moving, Hires Graphics, Sound effects, Thrust, Laser Torpedo, climb, descend, superbly detailed ..... **G4 + T5; £4.00**

ASTRO BATTLEZONE: fastened in the cockpit of your starcruiser, you view the 3D graphics of the earth revolving silently below, staring down your head up display you suddenly glimpse the enemy hurtling towards you, you turn at them, the horizon rolls over, the engines roar as you climb to the stars ..... **G4 + T5 £5.00**

FRUIT MACHINE: Our version has HiResgraphics, nudge, collect, respin, gamble and even plays "Oranges and Lemons" when you win ..... **G3 + T5 £4.00**

POLECAT: Countryside Packman, you must move your Rabbit through the underground maze, but you are being chased by a polecat so you must run like a rabbit until you've collected all your your carrots growing on the top of the Burrow. ..... **G4 + T5 £5.00**

MINEFIELD: You must steer your way through a perilous minefield without exploding any mines; blasting mines can cause chain reactions. ..... **G0 + T5 £5.00**

EARLY WARNING: Atomic Missile Command, destroy the attacking ICBMs using a realistic radar screen and intercept missiles. ..... **G4 + T5 £5.00**

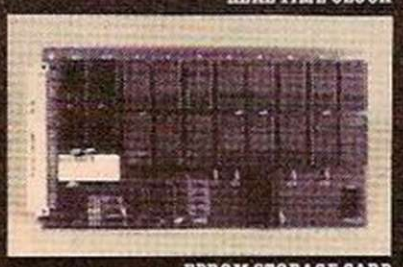
N.B. G = GRAPHICS T = TEXT

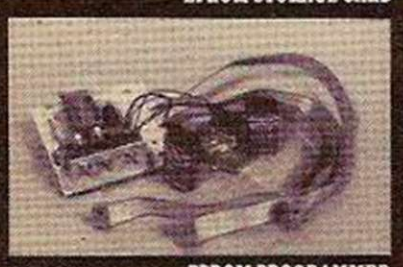
ANY 3 ONLY £9.00

Control Technology, 39 Gloucester Rd, Gee Cross, Hyde, Cheshire SK14 5JG.

All prices include VAT, P&P.
For other Products, see our advert on page 00

REAL TIME CLOCK


EPROM STORAGE CARD


EPROM PROGRAMMER

PROGRAMMABLE GRAPHICS MODULE

DOES YOUR SYSTEM NEED A PICK-UP?

THEN SEE THE

No. 1 'ADD-ON' PEOPLE
TANGERINE USERS GROUP

0202 294393

Membership discount scheme: up to 25% discounts available **NOW**
Send large (A4) s.a.e. for our comprehensive hardware and software listings... your system need never be alone with **TUG** support... get tuggin' it today. Send A4 s.a.e. for membership details – **TUG ON!**

Access Buy it with Access

THINK TUG!

TANGERINE USERS GROUP
16 Iddesleigh Road. Charminster.
Bournemouth. Dorset BH3 7JR.

SPECIAL OFFER

FOR

SINCLAIR OWNERS

The Acorn Dealers Association offer

£20 OFF any ACORN ATOM (kit or built) in exchange for any working ZX-81

Just take your ZX-81 to any of the dealers below and claim your £20 off. (Only one ZX-81 per Atom eligible).

Broadway Electronics
The Broadway
BEDFORD
(0234) 213639

Cardiff Micro Centre
46 Charles Street
CARDIFF
(0222) 373072

Silicon Centre
21 Comely Bank Road
EDINBURGH
(031-332) 5277

D.A. Computers
184 London Road
LEICESTER
(0533) 549407

The Centre of Sound
120 Nottinghill Gate
LONDON W11
(01-727 0511)

Customised Electronics Ltd
115 Marton Road
MIDDLESBROUGH
(0642) 247727

RDS Electrical
157-161 Kingston Road
PORTSMOUTH
(0705) 812478

3D Computers
230 Tolworth Rise South
Tolworth
SURBITON
(01-337) 4317

Quality Radio & TV Co
790 Alcester Road, Maypole
BIRMINGHAM
(021) 444 2889

Computer Shack Ltd
14 Pittville Street
CHELTENHAM
(0242) 584343

Service Centre
48 Lynedoch Street
GREENOCK
(0475) 20228

Mr Calculator
128/132 Curtain Road
LONDON EC2
(01-729) 4555

R.H. Murcott Ltd
Words End
LOUGHBOROUGH
(0509) 214444

Newcastle Computer Service
906-908 Shields Road
Walkergate, NEWCASTLE
(0682) 761168

Carvell of Rugby
9 Bank Street
RUGBY
(0788) 65275/6

Northern Computers
128 Walton Road
Stockton-on-Heath
WARRINGTON
(0925) 601683)

Eltec Services Ltd
231 Manningham Lane
BRADFORD
(0274) 491371

Vixon Computers Ltd
49 Grimsby Road
CLEETHORPES
(0472) 58561

P J Equipment
3 Bridge Street
GUILDFORD
(0483) 504801

P.A.J. Rentals Ltd
17 Hampden Square
LONDON N14
(01-368) 0572

NSC Computer Shops Ltd
29 Hanging Ditch
MANCHESTER M4
(061-832) 2269

S.P. Electronics
2 High Street, Hucknall
NOTTINGHAM
(0602) 632467

Computer Facilities
St Vincent House
Normanby Road
SCUNTHORPE
(0724) 63167

Computer Plus
47 Queens Road
WATFORD
(0923) 33927

Protocol Computers
114 Widmore Road
BROMLEY
(01-460) 2580

Microage Electronics
135 Hale Lane
EDGWARE
(01-959) 7119

Customised Electronics Ltd
Winker Green Mills
Stanningley Road, Armley
LEEDS
(0532) 792332

Off Records
58 Battersea Rise
Clapham Junction
LONDON SW11

Mansfield Computers & Electronics
79 Ratcliffe Gate
MANSFIELD, Notts.

Arden Data Processing
166 Park Road
PETERBOROUGH
(0733) 47767

Q-Tek Systems Ltd
2 Daltry Road
Old Town
STEVENAGE
(0438) 65385

Datex Micros
193 Tarring Road
WORTHING
(0903) 39290

MAIN GENIE DEALER

Premier Publications now offer the FULL range of Genie equipment, including expander boxes, disk drives and video monitors for the Genie and TRS80 I/III range. Samples prices . . .

GENIE I with cassette deck	£319.95 inc
GENIE II with numeric pad	£334.95 inc
40 track disk drive (EG400)	£219.95 inc
32K Expander Box (EG3014)	£214.99 inc
12inch black & white monitor	£69.95 inc
9inch high quality monitor	£92.00 inc
Parallel Printer Interface	£37.95 inc

PREMIER WORD PROCESSOR PACKAGES

Premier offer a wide range of WP packages for the hobbyist and small businessman, starting from as little as £370. All use our phenomenally successful WORD4WORD word processor which was our top-selling business program in 1981. Most of the packages use the CENTRONICS 737, a superb printer which is capable of correspondence quality output with three type faces, true descenders, sub/superscripts, underlining AND proportional spacing. The WORD4WORD supplied makes full use of the above features, and gives true right justification in proportional mode, whether the text is a letter or a series of columns. All disk-based packages are supplied with DOSPLUS.

WP1 W4W + GENIE II	£369.95
WP2 W4W + GENIE II + CENTRONICS 737 PRINTER + all cables	£759.95
WP3 W4W + 48K GENIE + 40 track disk drive + DOSPLUS + 737 Printer	£1245.00
WP4 as WP3, but twin drives	£1449
WP5 as WP4, but with twin double density disk system	£POA
WP6 W4W, GENIE II, disks and a daisywheel printer. Available MAY	£TBA

WORD4WORD

STUNNING NEW TRS80/VG WORD PROCESSOR

Why pay £75 to £150+ for a W.P? W4W gives you all the facilities you could wish for in WP for a senislbe price. Amongst the features included are:

FULL SCREEN EDITING & TWO WAY SCROLLING
FULL TEXT INSERT/DELETE ON SCREEN
GLOBAL SEARCH & AMEND
TEXT SEARCH — TOTAL TEXT MOBILITY
TEXT FORMATTING TO SCREEN OR PRINTER
CASSETTE/DISK STORAGE OF TEXT
VISION LOAD OF STORED TEXT
STANDARD LETTER ROUTINES
OVERTYPE CORRECTION
SINGLE KEY WORD DELETION
PAGE LAYOUT & NUMBERING
TOTAL PRINTER CONTROL
TEXT HIGHLIGHTING FOR U/L RECOGNITION
TEXT BLOCK MANIPULATION
COMPREHENSIVE TAB & TABLE GENERATION

Many other features are included in W4W. We would need several pages to do justice to this superb product. W4W is comparable to most purpose-built systems. COMMISSIONED AND DEVELOPED BY PREMIER WITH THE HOBBYIST AND SMALL BUSINESSMAN IN MIND.
Please state machine type and printer when ordering. W4W can cope with the Centronics 737/9 and Tandy proportional spacing modes. Price CASSETTE £33.95, DISK/FLOPPY TAPE £37.95.

S CREDT

This fabulous screen editor has the following features:
- twin cursors for easy editing
- two speed copying from second to main cursor
- complete mobility of new cursor
- user-definable cursor locations
- auto-repeat cursor movement keys
- thirteen new functions
- useable with most assemblers

SCREDT also allows the user to save a segment of screen information to memory for later retrieval/editing. SCREDT is a machine code program needing less than 2K of user RAM. It is compatible with Premier's TOOLKIT II, and locates at the top of memory.

Specify Model I, II GENIE I, II and memory size when ordering. Cassette £14.95. DISK (specify DOS) £16.95. Floppy Tape £17.95.

MICROTRAIN FOR TRS80/VG

At last you can combine two of the most popular hobbies in the country — railways and computing. MICROTRAIN, a brand-new quality simulation from Premier, allows you to set up a network of tracks, points, stations, tunnels, bridges etc and then run trains to your own timetable! Signalling is provided either automatically or to your design.

MICROTAIN is a screen-based simulation. With one keystroke you can draw and signal lines many scale-miles long. Trains can be run simultaneously and the speed and length of each train is user-selectable. A cursor is used to move the whole screen display left or right for visual inspection of any part of the network. You can use any of the machine's graphics on-screen to build up scenery. Designs can be stored onto tape/disk for future retrieval.

MICROTRAIN is a machine code program and will run on any Genie or TRS80. State machine when ordering.
CASSETTE £14.95 inc. DISK (specify DOS) £16.95 inc.

TOOLKIT 2 FOR TRS80 I & III/VG

TOOLKIT 2 features 17 new easy-to-remember command words and a machine code monitor which greatly enhance an already powerful BASIC

REPLACE	replace any string, word or variable
VARS	gives a list of variables on screen
TRACE	see line contents as executed
ABBREV	26 BASIC words become single-key entries
RENUMBER	operates from any start in any increment
BLANK	removes unwanted spaces and LET statements
VTAPE	true Vision load plus APPENDing
MC	a full machine code monitor
VARTRACE	lists lines as executed plus variables
PAGE	controlled list scrolling
OLD	retrieves lost programs!
FIND	anyting in a BASIC listing
REMKIL	kills REMS!
DUPL	copy existing line to new line
LFIND, LVARS, LREPLACE	all work to printer
PRICES	Cassette £29.95 Disk (Specify DOS) £32.95

POSTAGE & PACKING: Software 75p per order. Eproms/Discs 95p per order
GENIE HARDWARE POA
ALL PRICES INCLUDE VAT

BARCLAYCARD VISA

Premier Publications

We welcome Access

208 Croydon Road, Anerley, London SE20 7YX. Tel: 01-659 7131

YOUR LETTERS

ZX-81 ANIMATION

There are a few errors in my article "Smooth Animation for Games" in the February issue of *Your Computer*. In figure 1, line 103, the last instruction should be JR L4 (not JRL4). The first instruction in line 104 should be

L3LD A,(DE)

i.e. without a space before "(DE)".

In figure 2, the second byte should, of course, be 0E (not OE). In the last paragraph of text on page 52, the number to be Poked in locations 16515 and 16516 ranges between 1 and 791 (not 79, as printed).

John Watson,
Old Basing,
Hampshire.

SPEEDY VIC

I was interested to read the review by Tim Hartnell on the BBC Micro. The results of the counting-speed test were also intriguing. I own a Vic-20 and was curious to find out what my box of chips could do. The program I ran was as follows:

```
 1 PRINT "CLR/HOME"
 5 PRINT "CRSR6spaces rightSPEED
   TEST"
10 TI$="000000"
20 FOR N=1TO1000
30 PRINT "S" (note: cursor home)
40 PRINT N:NEXT
50 PRINT TI$
```

It took 11 seconds, compared to 14 seconds reported for the BBC Micro, to count and print to 1,000.

I realise that the form of the instructions can influence the running time of the program. For example, if the statement in line 30 is altered to CLRandHOME then the program takes 25 seconds to complete. Therefore I make no special claim for the Vic-20.

I must congratulate *Your Computer* on its content and presentation, both very appropriate to a beginner in computing like myself.

Stephen Clark,
Glasgow.

ZX-81 SCREEN

The program by Nigel Moats for Poking on to the bottom two lines of the screen on the ZX-81 — Software File, November 1981 — was quite long and not entirely crash-proof.

By Poking into DF-SZ it is possible to print on the bottom two lines of the screen. Poke 16418,0 will allow you to do this: it must be included in a program, and Input must not be used until you Poke 16418,2 or else the computer will crash.

The screen can also be shortened by Poking address 16418. Poke 16418,11 will only allow you to print on the top 12 lines, and Poke 16418,23 will only allow you to print on the top line.

Here is a short program that allows you to input a string and then print on the bottom line of the screen.

```
10 LET A$=" "
20 POKE 16418,0
30 PRINT AT 23,0;A$
40 PAUSE 100
50 POKE 16418,2
60 INPUT A$
70 GOTO 20
```

I have also written a short machine-code routine which will allow you to fill the screen with CHR$ 8 when called by USR. This subroutine fills the screen within a second in slow mode, and any character can be used by a simple alteration. The machine code can be Poked into a dummy Rem statement or into RAMtop. It only takes up 11 bytes, and should be called by RAND USR (starting address).

Phil Evans,
Newport,
Shropshire.

ZX-81 screen-fill routine.

Dec	Hex	Instruction	Notes
6,176	06,B0	ldB,176	
62,8	3E,08	ldA,8	The 8 here is to CHR$ to be printed change this to change the CHR$.
215	D7	rst 16	
215	D7	rst 16	Call print routine.
215	D7	rst 16	
215	D7	rst 16	
16,250	10,FA	djnz 250	Is it the end? If not jump back to 2nd line.
201	C9	Ret	Return to Basic.

BBC SERVICE

Since I am thinking of buying a BBC Microcomputer I was pleased to read your favourable conclusions concerning its qualities — *Your Computer*, January 1982. I am afraid, however, that the sale of this microcomputer might be hampered by the apparent lack of commercial interest shown by the BBC.

As the BBC Micro promised to offer excellent value for its price, I decided more than two months ago to ask for general information as well as an order form. To my disappointment I have not yet received a reply from the manufacturer.

Fortunately I happened to obtain the general information required from one of my colleagues. I made up my mind to buy model B of the micro, but to be sure to order a complete system in working order I still need more details on the contents of the initial package.

I wonder whether the BBC is simply unwilling to take any notice of my requests, or whether it has decided not to sell its attractive product abroad. I fear that this lack of interest might make its influence felt on the after-sales service as well, and this factor will no doubt discourage potential customers from the Continent.

Can anyone tell me how to get in touch with the BBC Microcomputer sales service, before my enthusiasm for the British microcomputer wanes?

D H Joziasse,
Alphen,
The Netherlands.

SOUND-BOX

Readers may have had difficulty in obtaining the transistor for my ZX Sound-Box project — Software File, December 1981. I used an AC169 in the prototype, but the actual number is not too important as long as it is PNP. As an alternative I suggest an AC126 which is available from Watford Electronics, 33/35 Cardiff Road, Watford, Hertfordshire.

I would also like to mention an error in the article. Where A4 is stated, it should read A3. Although connection to A4 will not damage the computer in any way, it will change the port address. To correct the fault simply remove the connection from the computer or edge connector and replace it on the A3 line.

J Chalmers,
East Grinstead,
West Sussex.

VIC-20 INPUT

I am the proud owner of a Vic-20 and, so far, I am quite pleased with its performance. My machine does have a few bugs though, and I wonder how many others are like it. I assume that the problems which I have are caused by the Vic, rather than by my lack of knowledge, so perhaps this letter will inform others.

The first bug is in the Input statement. The Vic manual says that a message can be put in quotes between the statement Input and the variable name. On my Vic this is only valid if the message can be printed on one screen line. Should the message run on to a second screen line then the Vic thinks that the message is part of the input. For example,

```
INPUT "The Voltage"; V
```

runs to perfection, but

```
INPUT "The number of volts at A"; V
```

produces a Redo From Start error message because the Vic inputs not only the number, when return is pressed, but also the message "The number of volts at A" which, of course, cannot be input to a numerical variable. If one tries

```
INPUT "The number of volts at A"; V$
```

then it runs but on printing V$ one sees that V$ = The number of volts at A 6 — if 6 was entered in response to the prompt.

I have devised two ways to surmount the problem, although there may be others. You can set the cursor to a new line either by means of the cursor controls after the prompt, or by putting a cursor movement in the Input statement. This effectively puts the information being typed in on a new line.

Alternatively, you can put the message in a Print statement before the Input statement and keep the Input statement to one screen line.

The second problem concerns string length. The manual declares that strings may contain up to 255 characters. I agree, but just try to type in more than 88 at a time. The Vic won't have it. If I type in 89 characters — i.e., more than four screen lines — then only the 89th character is accepted on pressing Return. The Vic won't accept more than four lines at a time. The only way my Vic will do this is to input the string in four-line parts, and then add them together as in the following routine.

```
 1 B$=" "  REM EMPTY STRING
 5 INPUT A$
10 B$=B$+A$
15 PRINT CHR$(147) REM CLEAR
   SCREEN:PRINT B$:PRINT
20 PRINT"PRESS 1 TO ENTER
   MORE":PRINT
25 PRINT"PRESS ANY OTHER KEY
   TO END":PRINT
30 GET Z$:IF Z$="" THEN 30
35 ON VAL(Z$) GOTO 5
```

In this way the string variable B$ is slowly filled with information in four-line chunks of A$, and the maximum 255 characters can be input. There may well be other methods of doing this involving less effort, but I have not found them yet.

Is my Vic unique in having these two bugs, or have I really missed something in the manual?

David Robinson,
Llantwit Major,
South Glamorgan.

LIFEBOAT APPEAL

I am the chief fund-raiser for the Appledore Lifeboat Station and we sell about £7,000-worth of RNLI souvenirs, etc., each summer. I run an open-air stall on Westward Ho! promenade selling some 70 different items.

For the last year we have been keeping details of turnover each hour, together with weather conditions and tide. The latter is important as there is no sand at high water, and so more people on the Promenade and more sales. The stall is open on about 80 days during the season.

I have just acquired a ZX-81, on which I would like to run a program from which we can extract the best times and the best days, with coded weighting values for weather and tide. Or, perhaps, we would compute an average take between three and four o'clock on Sundays when the band is playing.

Are there any local ZX-81 users who would be willing to help?

Colin Lowry,
Buckleigh House,
Westward Ho!,
Devon. ■

Education on the ZX-81

SCISOFT, A software company formed by a group of science teachers last year, has launched two educational programs for the Sinclair ZX-81. Markbook, £4.50, is a menu-driven utility program for teachers which will sort lists of pupils into alphabetical, form or rank order.

Revise at £27.95 is a package devised for pupils studying for O level physics. More details from Scisoft, 5 Minster Gardens, Newthorpe, Eastwood, Nottinghamshire.

Super Vic and CBM 64

COMMODORE International Ltd plans to launch two new microcomputers this year, the Super Vic and the Commodore 64. The Super Vic is a 16K full-colour, 40-column micro expected to cost about £212. The Commodore 64 is also a full-colour, 40-column micro, but has 64K of in-built memory and should cost about £315.

In addition, Commodore is planning to introduce Ultimax, a combination of video game, microcomputer and music synthesiser. A computer membrane keyboard allows the video game to be used as a micro with a built-in memory, while a second keyboard enables the Ultimax to function as a music synthesiser which can duplicate the sounds of a piano, harpsicord, clarinet and other musical instruments.

None of these three machines is likely to be available in Europe until later in the year, or early 1983, but they will be on display at the Hanover Fair, West Germany, in April, and the Pet Show in June.

Top of class in software

A RECORD entry is expected for this year's national computer software competition for schools and colleges throughout the U.K.

Run by the University of Kent, the competition is designed to foster an awareness among schools of the industrial and commercial uses of computer systems.

The competition is divided into two classes, one for students under 16 and one for students under 19. Winning students in each category will be awarded a £400 cash prize and the computing department of the winner's school or college will receive up to £1,000 of equipment.

Experts confounded as machine out-thinks grandmaster Nunn

WORLD CHAMPION chess computer the Chess Champion Mark V caused an upset during a man-versus-machine chess problem-solving contest in Brighton, East Sussex. The Mark V not only beat John Nunn — the current British chess problem-solving champion — five times out of six, it also found three correct solutions to one problem. A chess problem is supposed to have only one possible solution.

The problem with the three solutions was originated by a leading Russian chess-problem expert L Zagorujko in 1972. The problem has appeared in newspapers and magazines around the world, but no-one had found a solution other than the one proposed by Zagorujko.

The Zagorujko problem was one of six set before Nunn and the Mark V by Barry Barnes, vice president of the problem commission of the World Chess Federation. Nunn was unable to find a solution to the problem, but the Mark V confounded the experts by finding Zagorujko's solution and two alternatives of its own.

Andrew Page, U.K. general manager of SciSys which manufactures the Mark V, said: "It shows that chess computers have reached a level of sophistication which makes them essential for organisers of chess competitions, and for chess players who want to verify results or analyse matches.

"There are certain areas of chess in which computers are already capable of deeper analysis than humans. The day of the unbeatable chess computer is fast approaching".

The Chess Champion Mark V is made in Hong Kong by SciSys and distributed in the U.K. by Vulcan Electronics, 200 Brent Street, Hendon, London NW4. Telephone: 01-203 5161.

Dr John Nunn, right, and the Mark V ponder the Zagorujko problem, watched by international master David Levy.

All the fun of the Fair

PHAROAH HUGHES Associates Ltd is offering a package deal for the Computer Fair, which is being held at Earls Court exhibition centre from April 23 to 25.

Under the deal, visitors to the Computer Fair will be able to stay in twin-bed rooms at either the three-star St James Hotel or the two-star Cranley Gardens Hotel. Continental breakfast and admission to the Fair is included as part of the deal. The package costs £15.30 per person for each night at the three-star hotel and £13.80 a night for the two-star hotel.

In addition, Pharoah Hughes will arrange reduced rate second-class return rail tickets for its package deal customers.

Sponsored jointly by *Your Computer* and *Practical Computing*, the Computer Fair will cater for all microcomputer users from the home enthusiast to the small businessman.

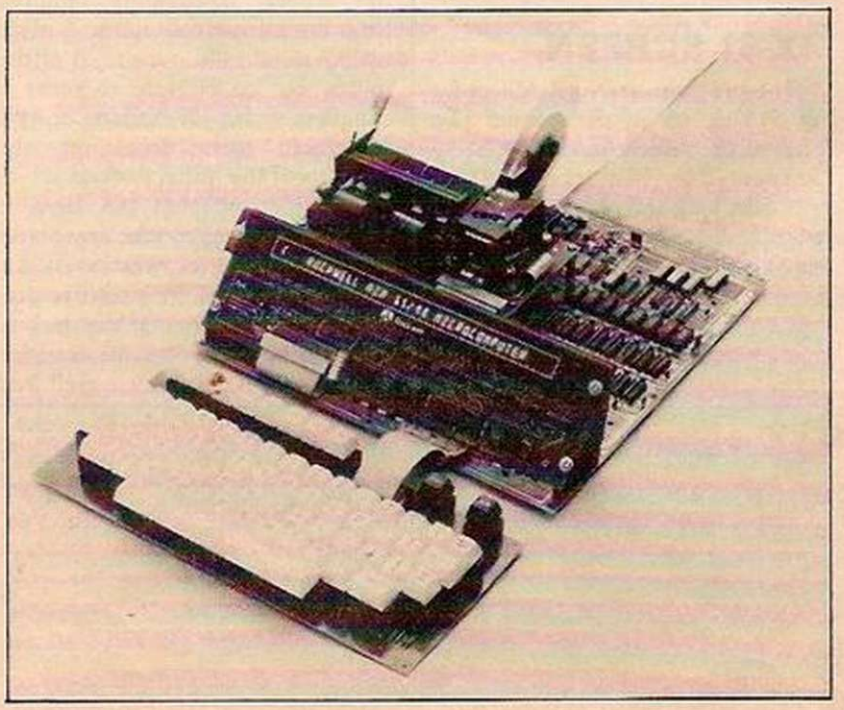
More information about the Computer Fair package deal is available from Pharoah Hughes Associates Ltd, Lamb House, Church Street, Chiswick, London W4 2PD. Telephone 01-995 8995.

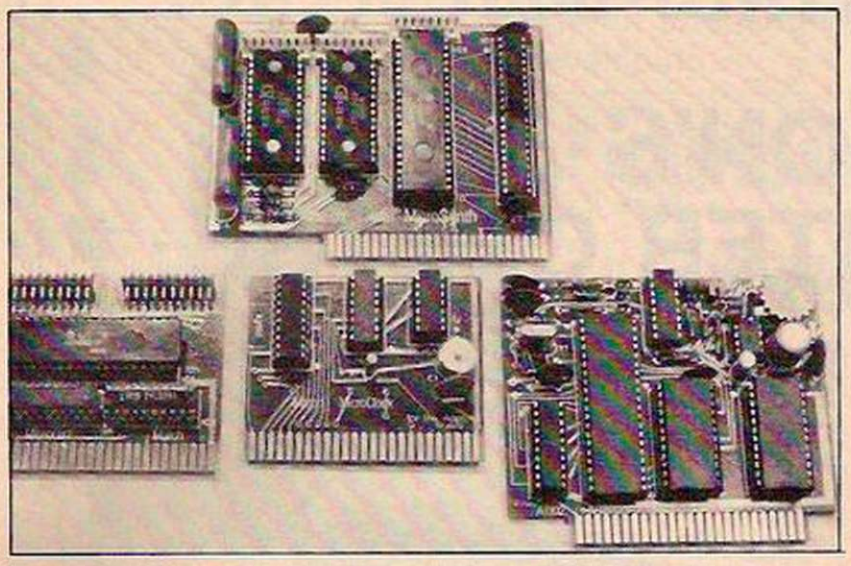
Adventure in machine code

ADVENTURE C is the third in a series of Adventure games written entirely in machine code by Artic Computing. An alien cruiser is on a slave mission with the aim of capturing humanoids and replacing their brains with microchips. You must escape from the cruiser if you can. The program is available on cassette and costs £9.

Artic's second new game is ZXChess II which plays on seven levels and costs £15. The fastest response time is one second, says Artic, and the first five levels play within three minutes of a move. The game also contains an analysis routine. Artic Computing, 396 James Reckitt Avenue, Hull, North Humberside.

The Rockwell Aim 65/40 microcomputer with 40-column vacuum fluorescent display has been launched by RCS Microsystems. Designed principally for laboratory instrumentation and software development applications, the Aim 65/40 includes 48K RAM, 32K ROM and user RS-232, and an on-board 40-column printer with full graphics capability. Software development is supported in assembler, Basic, PL/65 and Forth languages. A monitor provides a text editor with screen editing, monitor-command-string processing and symbolic debugging. Full details from RCS Microsystems Ltd, Gresham House, Twickenham Road, Feltham, Middlesex TW13 6HA. Telephone: 01-898 4761.





Four peripheral cards for the Apple II and III have been launched by March Communications Ltd. MicroClock is a real-time clock with registers ranging from tenths of seconds to leap years. MicroTalker is a speech synthesis card using the National Semiconductor Digitalker chip set, while MicroSynth is a sound and music synthesiser card which uses the AY-3-8912 device. MicroPort consists of a dual eight-bit parallel input/output card. More detailed information about the cards can be obtained from March Communications Ltd, 14-16 Manchester Street, Liverpool L1 6ER. Telephone: 051-236 2000.

2K EPROM for Sinclair

AN EPROM card for the ZX-80/81 has been developed by Orme Electronics. The card uses a 2716 EPROM with a 2K capacity for machine code and is designed to work in the space immediately above the Sinclair internal ROM. An additional 6K of space is available for future development.

The EPROM card has an edge connector and can be fitted to either the ZX-80 or the ZX-81, though the ZX-80 has to be modified by cutting the track leading to pin 20 of the ZX-80 ROM and soldering a 680 resistor across the breach. A wire then must be connected from the resistor to the 23B position on the edge connector.

The card is supplied with a pre-programmed EPROM which contains 11 utility-type programs including a renumbering program and a program for converting decimal to hexadecimal. The EPROM also includes the game Life which simulates the survival, growth or eventual death of a colony of cells.

The EPROM card and the programmed EPROM cost £17.95 and are available from Orme Electronics, 2 Barripper Road, Camborne, Cornwall TR14 7QN.

Basic games on new cassette

MICHAEL ORWIN has released a second cassette of programs for the ZX-81. Cassette 2 contains 10 games in Basic for the ZX-81 with 16K RAM. The games include Othello, Laser Bases, Pontoon, Rectangles and Word Mastermind. Side A and side B contain the same programs, but in a different order.

The cassette costs £5 from Michael Orwin, 26 Brownlow Road, Willesden, London NW10 9QL. Telephone: 01-965 4676.

BBC Micro price rises

THE PRICE of the BBC Microcomputer increased by £75 to £299 on February 1, while the cost of the enhanced model rose from £335 to £399.

All customers who placed orders before February 1 will be charged at the old rate, but orders received after

that date will be charged the new prices.

Chris Curry, managing director of Acorn Computer Ltd, which is manufacturing the BBC Microcomputer under licence, said: "The original pricing structure has proved to be too optimistic, given the need for particularly rigorous tests.

Acorn is confident, however, that it has solved the flawed-microchip problem that has delayed production of the BBC Microcomputer. The 12,000 outstanding orders should be cleared by the end of March.

Cost of Atom ROM cut

WILLOW SOFTWARE has cut the price of its 4K utility ROM for the Acorn Atom. The ROM, which provides 18 additional facilities for the Atom, is now being retailed for £26 plus VAT and post free. Contact Willow Software, PO Box 6, Crediton, Devon, EX17 1DL.

Graphics package that draws on your skill to create on screen

THE BIT STIK creative-graphics system designed and produced by Robocom Ltd enables microcomputer users to draw multi-coloured sketches, diagrams and graphics without having to input instructions via a keyboard. A DOS 3.3 disc allows the user to draw directly on the video screen using the Bit Stik as the only input.

A comprehensive menu can be called at the edge of the screen and accessed by pointing to the required items with the drawing cursor. The menu provides pallet facilities for automatic lines, arcs and circles, four line types in six colours and a variable nib for colouring and lettering.

An automatic paint facility allows line drawings to be coloured using up to 16 colours. Mode selections for the menu include Zoom, for detailed drawing and viewing, Copy, for reducing and compiling, and Find, which locks on to a particular point.

A secondary menu can be used to save and load drawings on to floppy disc, enabling the user to build up a file of drawings. Other selections allow the user to position text at any scale, angle or colour in a drawing, while Animate permits the dynamic recording and replaying of a series of drawings.

In addition, a lock function provides two angle and two grid locks to assist in the drawing of three-dimensional views and grid-based layouts as used in typography and circuit diagrams. If required, an X,Y selection displays the co-ordinates of the cursor on the video screen while drawing.

Two pages are available at any one time for direct drawing or to hold components of the work in hand. Each page can hold up to 16,000 pages of information which can be viewed by zooming in on specific areas. A memory counter indicates the available workspace while a compress function allows drawings to be squeezed into the minimum memory space.

A short interface program allows paper copies of the drawings to be produced on any X,Y plotter. The resolution of the drawings is limited only by the capabilities of the plotter, not the original video page, says Robocom.

An illustrated user manual contains instructions and examples for using the Bit Stik, as well as information on writing programs and using drawings in other routines. The Bit Stik can also be used without any software as a precision games controller for all paddle-operated games.

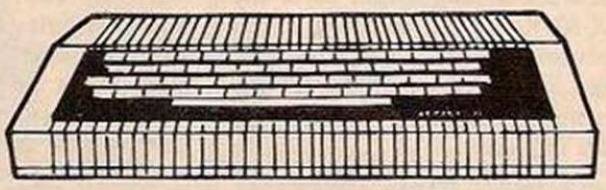
At present, the Bit Stik system is only available for use with a 48K Apple system complete with DOS and colour or black-and-white monitor. Depending on demand, Robcom plans to produce interface modules and modified software for other microcomputers.

The Bit Stik graphics system costs £185 plus VAT, post and packing free, from Robcom Ltd, Cil Trading Estate, Fonthill Road, London N4.

·JUST OPENED · JUST OPENED · JUST OPENED ·

·LONDON'S·
·HOME COMPUTER CENTRE·

·ACORN·



·BBC·

·PET·

·VIC·

·GAMES·HOME FINANCE·EDUCATION·
·ALL YOU NEED·ALL EXPLAINED·

There's a fantastic choice of home computers on the market today. Each one brilliant in its own right. But which one's right for you?

The jungle stops here! At Microstore, we'll understand your requirements and advise you on the best model.

From business or household management, to education or entertainment, there's something for you.

Hundreds of items and accessories on display.

Business Computers
Apple II and III
Talk your requirements over with a practical business man.
Books, Disks, Printers, Programs, and all the back-up.
Also full after-sales-service.

·Come and see them before you buy·

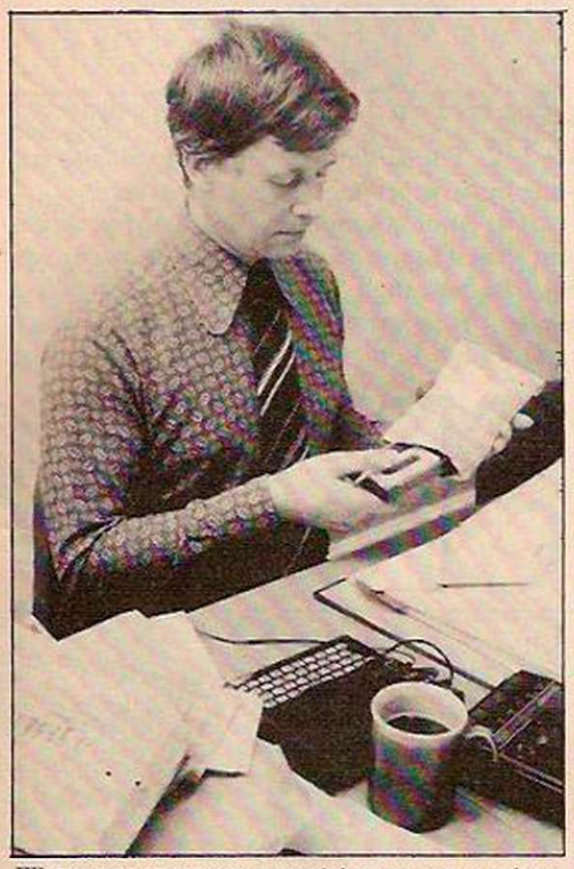
MICROSTORE

·327·KING'S ROAD·LONDON·SW3·
·PHONE·01·352·9291·

MICROSTORE

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.

ZX schools' group yields support and information



Educational Users' Group pioneer Eric Deeson (left) tells Brendon Gore of the difficulties in persuading teachers to get down to writing programs for their micros.

WITH POLITICIANS promising to put a microcomputer in every secondary school, and the BBC launching its computer-literacy series, a growing number of schools have become aware of the need to offer computing courses in the curriculum. EZUG, the Educational ZX-80/81 Users' Group, is committed to encouraging more schools to use the ZX-80/81 in the classroom.

Founded by Eric Deeson in December 1980, with support from Microcomputer Users in Secondary Education, MUSE, EZUG is a self-help group of teachers, pupils and parents. It is a non-profitmaking organisation with more than 1,000 members in more than 20 countries including the Philippines, India, Malawi and Australia.

At the centre of EZUG's activities is a bi-monthly newsletter which consists of news, reviews, tips on programming, solutions to hardware and software problems and answers to members' queries. Eric Deeson started the newsletter as a guide to writing programs for the MUSE software library with the aim of developing a section of ZX-80/81 programs suitable for use in both primary and secondary schools.

The primary task

This is still the newsletter's primary task, but it now includes competitions, questions on insurance and a host of advice for Sinclair users in education. A year's subscription costs £2.50.

The MUSE library, which distributes software to members on a commission basis, has about 100 programs in stock, mainly for the 380-Z, Pet and Apple. This gives MUSE members access to a large number of programs designed for use in schools.

The copyright for each program is retained by the author who is free to distribute his program elsewhere, providing he does not undercut the MUSE price.

EZUG's policy of encouraging members to write software for the MUSE library is starting to pay dividends. About 50 programs have been submitted to Eric Deeson for inclusion in the ZX-80/81 section of the MUSE library, most of them arriving in the last two or three months.

Of these programs, 14 have been accepted, two were withdrawn by the authors and 14 were returned for rewriting. Only 10 were rejected while another 10 are still in the pipeline. The accepted programs include Taxi, which simulates the problems encountered in running a taxi business, and Titrations, which determines the quantity of a given chemical in solution. Programs sent to EZUG are examined by Eric Deeson and two or three independent assessors.

"The criteria for assessment are very difficult to determine", admits Eric Deeson, "but none of the programs submitted so far has been rejected solely because of bad programming".

Ideally, says Deeson, potential contributors should adopt a two-person approach to educational software programs. A teacher who is not an expert programmer would benefit from collaborating with an experienced programmer and vice versa.

With primary school teachers constituting 30 to 40 percent of EZUG's membership, there should be no shortage of potential programmers. "Unfortunately, teachers, like other people, are often somewhat frightened of submitting their own programs to outside scrutiny", explains Deeson.

Reluctant encouraged

In a bid to encourage reluctant programmers, Sinclair Research has created an award scheme for educational ZX-81 software. Six ZX Printers will be awarded for the best programs accepted for the MUSE library by the end of March 1982. The programs will be judged by Eric Deeson, EZUG organiser, and Charles Sweeten, MUSE software librarian.

Criteria for assessment will include a program's acceptability for a specified educational role, novelty, the use of graphics where applicable and the standard of programming. Only MUSE members are eligible for the awards — the closing date for entries is February 27.

"The award scheme shows that Sinclair Research is now aware of the education market", says Eric Deeson. "The company is showing willing, though I would like to see it allocating some money to help with EZUG's printing costs".

EZUG's most recent venture was the publication of its *Directory of suppliers to the ZX market*. The *Directory* lists some 150 ZX suppliers and their products under eight classifications including national user groups, memory expansions, hardware add-ons and software. The *Directory* costs £1 and is available from EZUG, Highgate School, Birmingham B12 9DS. A second edition will be launched in six months, if there is sufficient demand. ■

Local society news

Glasgow

IAN WATT of 107 Greenwood Road, Clarkston, Glasgow G76 7LW has formed a ZX-80/81 Users' Group for the Glasgow area. "One of the club's main aims is to encourage computer literacy", says Watt. When the club is fully organised it hopes to include a section for the BBC Microcomputer. Anyone interested in joining the club should write to Ian Watt, or telephone 041-638 1241.

Cumbria

THE RECENTLY formed Furness Computer Club which meets at Dalton-in-Furness is looking for new members. Information about the club can be obtained from Arthur Gay, 24 Rusland Crescent, Ulverston, Cumbria LA12 9LX. Telephone Barrow (0229) 52854, between 6 and 7pm Monday to Friday.

Edinburgh

THE SCOTTISH Amateur Computer Society meets at the Claremont Hotel, Claremont Crescent, Edinburgh, on the first Wednesday of each month at 7.30pm. Members are encouraged to bring their own microcomputers to the meetings which usually include talks, demonstrations and education sessions for beginners. Visitors are always welcome. Further details from the secretary, Peter Lindsay, 1 Lower Gilmore Place, Edinburgh. Telephone 031-229 6841. ■

ZX-81 RAM SURVEY

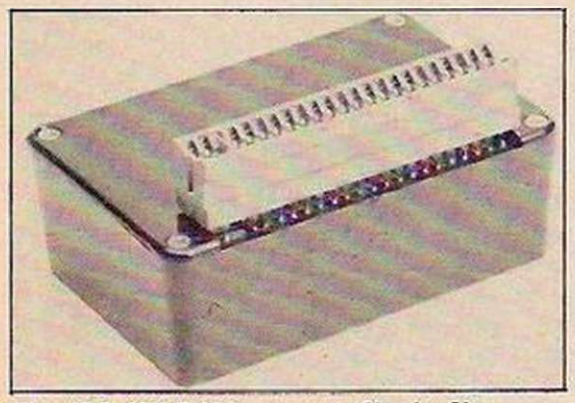
Stephen Adams tests and compares a clutch of seven of the main RAM packs on the market for reliability, expandability and value for money per kilobyte.

ONLY ONE of the review RAM packs was supplied without the 40-way edge connector needed to create the interface with the ZX-81 through its expansion port. These edge connectors are soldered directly on to the RAM's printed-circuit board. This means that the weight of the RAM pack and all its components pull the edge connector contacts away from the ZX-81. Also, when the keyboard is pressed at the edges, it tends to lift the back of the ZX-81 and the RAM pack with it. Both these instabilities can mean that laboriously-entered problems are lost.

The manufacturers use several methods to overcome these defects. One is to add a foam rubber strip just above the RAM pack edge connector. This foam strip, which is about 0.25in. thick, stops the RAM pack wobbling by creating a wedge. With this method, the RAM pack does not move unless firmly struck on the keyboard — as a small child might.

Two manufacturers have employed this solution, JRS Software and Hilderbay. Their RAM packs are identical, and are 2in. by 1.5in. including the edge connector.

The two 4K RAM packs — 3K of on-board RAM and the internal 1K of RAM — used



The JRS 16K RAM measures 2in. by 3in.

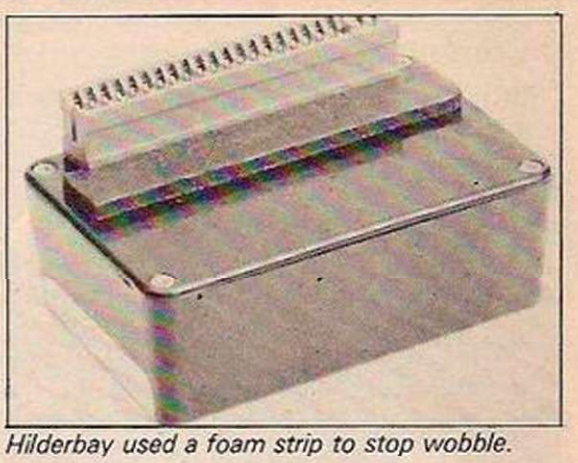
tighter edge connectors and were the most stable of all. The edge connector on the Audio Computers 32K RAM pack made it extremely difficult to use. The only way I could find to keep it steady was to pull the top of the RAM pack forwards and bind it to the top of the ZX-81 with a 6in. piece of insulation tape. This meant that the edge connector was held tightly against the ZX-81's expansion port. It also meant that the RAM pack could not even be used just after switching on the power and was certainly the worst case I encountered.

The Sinclair Research 16K RAM pack has no foam strip on its case, but by attaching a piece of foam to the ZX-81 and the RAM pack with double-sided sticky tape, you can make it immovable. It also emits an annoying hiss, absent in other RAM packs. This must be due to its use of a small transformer to produce the required voltages.

The Memotech 48K RAM pack was attached to the ZX-81 by a small board, holding the edge connector and a ribbon-cable connector. The ribbon cable connects to a similar printed-circuit board arrangement to connect to the RAM pack. As these boards are virtually weightless, they place no strain on the ZX-81 expansion port. The ZX-81 sits on a well in front of the hump of this RAM pack and this eliminates the problem caused by the keyboard flexing. A sticky pad is provided to hold the ribbon cable in place.

The power for almost all these RAM packs is produced by the Sinclair power pack, via the edge connector +9V line and the internal +5V regulator — the two exceptions are the Memotech and the Audio Computers RAM packs. Both these functioned satisfactorily, even when loaded with a motherboard and two extra boards.

The Memotech powers the ZX-81 separately from the RAM pack via a 3.5mm. plug on a 1ft. long cable which leaves the left-hand side of the hump. The hump contains two mains transformers fed from a filtered and fused supply. One transformer feeds the ZX-81, the other supplies the RAM pack with



Hilderbay used a foam strip to stop wobble.

+12V. The 9V line to the ZX-81 will also run the Sinclair printer without any trouble.

The Audio Computers 32K RAM pack was supposed to run with the Sinclair power pack; it does not, though I did not try the modification to the power pack suggested in which you add 1.5m. of enamelled wire to a

number of turns around the transformer. That should raise the voltage of the transformer to 11V. I do not think it should be attempted by anyone who is not building the RAM pack as a kit. Instead, I replaced the Sinclair power pack with a proper +12V unregulated supply which was home-made and which worked well enough after the RAM had been secured as explained.

It took, however, a good deal of pulling the power plug in and out to reset the RAM pack. A +12V power supply is available to power the RAM pack from Audio Computers, but unless you intend to install it in a case, the mains connections are exposed which could be dangerous.

The +12V supply, if used to power the ZX-81, could cause the +5V regulator to overheat. Therefore, the manufacturer provides a link so that an external power supply can run just the RAM pack.

PACKS

Quicksilva, Memotech and the Audio Computers are the only ones to use sockets for the integrated circuits, which means that the boards can be easily checked and faulty components changed quickly.

All the dynamic memory chips used in the 16K, 32K and 48K packs are industry standard 4116s. These are 16K by one-bit chips and you need eight of them to give the eight-bit byte required by the ZX-81's Z-80A microprocessor. They also required a special signal called $\overline{\text{REFSH}}$ given out by the ZX-81. This tells the RAM when to refresh its memory by reading from one bit and writing it back into the same location.

This must be done in a cycle, so that every memory is refreshed before the capacitors which hold the memory bits discharge. If this is not done, the memory bits are corrupted. This cycle is 2ms. long and 16K of addresses must be covered in this time. Therefore, if any interruption is made to this process, the data stored is corrupted.

The static RAM chips used on the 4K RAM boards are the standard 2114 chips used in some ZX-81s. They need no refresh signal since the bits are stored in a latch which holds them until the power is removed from the chip. Then the data is left scrambled. Only

A full 48K from the Memotech pack.

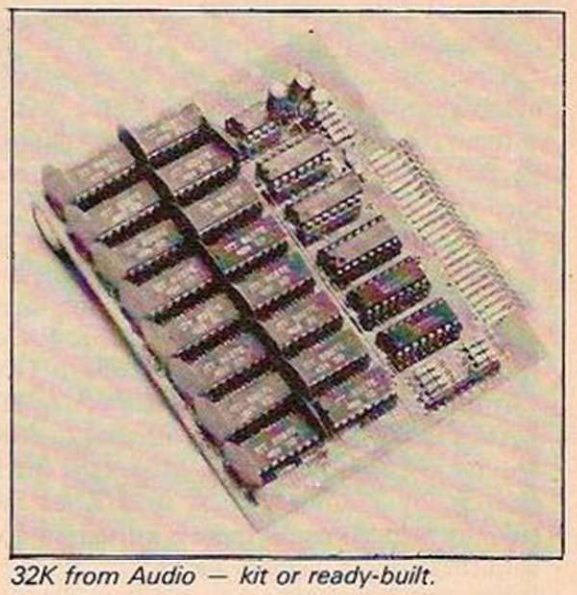
four bits are stored for each memory location, so two chips are required for each 1Kbyte of data to be stored.

The main reason for using dynamic memory is that it can store 16K in just eight chips — static memory would need 32. Dynamic thus saves both power and space. The type of chip used on the Audio Computers 128K board is a new design which can store 64K by one bit. They take even less power than the 16K version.

The amount of memory which can be stored depends on the amount of space the microprocessor can address directly. Because the ZX-81 uses a Z-80A, which has 16 address lines, A0 to A15, the maximum amount of memory which can be addressed is 64Kbytes. This is the maximum number when all address bits are binary 1.

To decode these address lines correctly, the logic circuitry between the address lines and the actual memory chips must operate the memory chips only when the correct address appears on all 16 address lines. Since the minimum 1K chip will handle the address lines A0 to A9 inside the chip, we need decode only the address lines A15 to A10 externally to operate the chip-select pin CS.

Sinclair Research, however, decided to reduce the amount of logic gates required to decode this memory by dividing the memory



32K from Audio — kit or ready-built.

map into four sections. This meant that each could be decoded by using only the address lines A15 and A14. This is why the maximum RAM available according to Sinclair was 16K — 64K ÷ 4 = 16K.

All the RAM was supposed to be turned on only when A14 was binary 1; the ROM containing the Sinclair 8K Basic was turned on only when A14 was binary 0 and the display was turned on only when A15 was binary 1. This meant that the 1K internal memory was appearing 16 times in the 16K memory map as any address in that section operated the CS of the 1K chip.

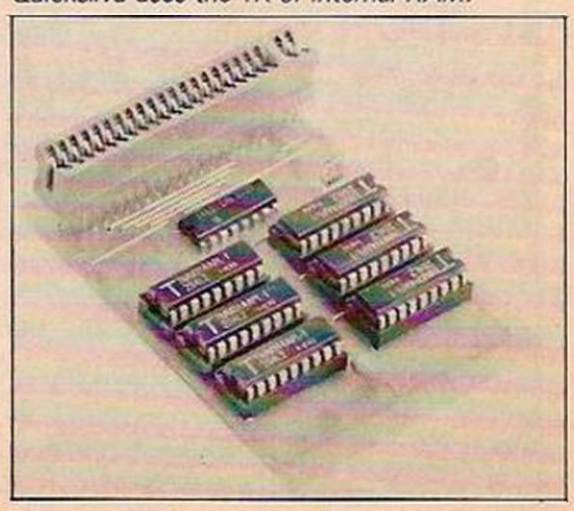
When the 16K pack was introduced this had 16K of memory inside it, properly decoded into its correct 1K sections. So the internal 1K RAM is permanently disconnected by the 16K RAM pack so that it does not interfere. This is done by the $\overline{\text{RAM CS}}$ line on the expansion port.

This inexpensive method of decoding the RAM and ROM also leads to problems if you want to install more memory. For instance, the ROM not only appears at 0 to 8K on the memory map but also any time A14 is binary 0. Therefore, it appears at 8K to 16K, 32K to 40K, and 40K to 48K as well. The 16K of Sinclair RAM also appears at 48K to 64K and this is used to advantage in the programming of the ROM for the screen display.

That is, however, a disadvantage if you want to install more memory in this space as the 48K to 64K is necessary to display the screen and cannot be used. Help is at hand in the form of the $\overline{\text{ROM CS}}$ line on pin 23B of the expansion connector. By connecting this pin to binary 0 at the correct time, the ROM can be turned off completely from the memory

(continued on next page)

Quicksilva uses the 1K of internal RAM.



(continued from previous page)
map and extra RAM inserted. This is one of the reasons that these packs for over 16K cannot be used on the ZX-80 8K ROM without internal modification. The ZX-80 has no $\overline{\text{ROM CS}}$ line on pin 23B as it was not used.

The ROM, when setting Basic, expects to see all the RAM starting at 16K on the memory map, so no extra Basic memory may be used below 16K. The normal 16K RAM pack is addressed then into the 16K to 32K part of the map. The Audio Computers 32K RAM pack extends the Basic memory to 48K on the memory map; the Memotech pack extends, by a cunning trick, to 64K on the memory map. As usual, there is a disadvantage with these larger memory packs.

Add-on requirements

The first 16K must contain any machine code to run from Basic. It must also contain the display file. Furthermore, since the display file sits on top of the program, the program and display file must not leave the lower 16K or the program crashes without warning.

Since the RAMtop is altered to show Basic that there is extra memory available, nothing can be stored above RAMtop. The extra 16K and 32K provided over and above the normal 16K must, therefore, be used only for storing variables and stacks. Yet machine-code routines could be transferred for running into the lower 16K from the variables section. This would have to overwrite a previous machine-code routine in order not to disrupt the Basic listing.

Certain add-on boards use the 32K to 48K region for ports, sound, new character set. So when buying one, remember that you cannot have two devices using the same memory location. The 128K RAM extension, using the new 64K chips, is divided up into 32K sections and only one can be used at a time. They are presented with manual switches which select the 32K section you want to use. The 32K section, after a manual switch, must be set up by using a reset button. This means that the memory has to be cleared of any program before use.

Audio Computers suggests using an input/output port to switch these sections or banks of memory.

The program to run this would have to be situated in the 8K space above the ROM because it must be immune from the switching of RAM banks. A special routine would have to be written in machine code to do the switching and cope with the transfer of variables between programs in different banks. It would be complicated to write and would require both hardware and software knowledge to write. Audio Computers is offering prizes for applications using the 128K pack on the ZX-81.

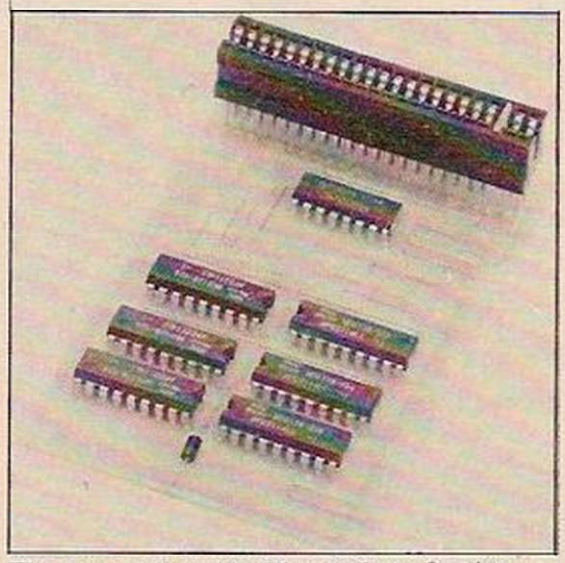
We performed a soak test on all the units. This consisted of 12 hours continuous operation with a memory check program to detect any corruption of the bits in memory. The only one to be affected by this long running time was the Memotech 48K which overheated the ZX-81 and corrupted the data.

The ZX-81 sits on top of the Memotech and some of the heat from the RAM underneath rises, just where the regulator for the ZX-81 is housed. The regulator is already relatively hot and this just pushes the temperature to an unworkable level. If separated by an insulated material from the ZX-81, the problem does not occur.

Adequate instructions were included with all the RAM packs, most of them consisting of a Poke 16389,X where X is the size of memory available. A New then starts the ZX-81 testing and searching the RAM from this point, setting the RAMtop at the highest location found. The two kit instructions for the Memotech and Audio Computers were excellent, apart from Audio's lack of a circuit diagram, and the fact that the capacitor C1 is not mentioned anywhere except on the printed-circuit board. ■

Company	Capacity	Price
Quicksilva, 95 Upper Brownhill Road, Southampton, Hampshire. Tel: 0703-771248	4K	£18
Memotech Ltd, 103 Walton Street, Oxford.	48K	£148.35 assembled £125.35 kit 15 percent educational discount.
Sinclair Research, Freepost 7, Cambridge CB2 1YY.	16K	£52.90
Audio Computers, 87 Bournemouth Park Road, Southend. Tel: 0702-613081	32K — with 16K of RAM — with 32K of RAM 128K	£37.95 £51.75 £141.45
Ceedata, Lead House, Arnfield Close, West Molesey Trading Estate, East Molesey. Tel: 01-941 4889	3K	£16
Hilderbay Ltd., 8-10 Parkway, Regents Park, London NW1 7AA. Tel: 01-465 1059	16K	£42
JRS Software, 19 Wayside Avenue, Worthing, Sussex BN13 3JU. Tel: Worthing 65691 (evenings)	16K	£35

All prices include postage and VAT.



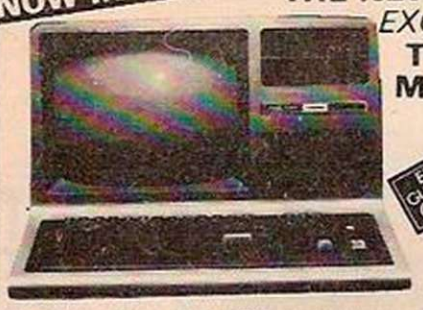
The extremely stable 4K pack from Ceedata.

CONCLUSIONS

- The two 4K static RAM packs from Quicksilva and Ceedata are 3.5in. by 2.5in. printed-circuit boards which use the 1K of internal RAM as part of the unit. They are well made and extremely stable. Their memory capacity cannot be augmented.
- The 16K RAM packs from JRS and Hilderbay are supplied in neat black boxes, 2in. by 3in. by 1.5in. They are as stable as the static RAM, but the cost per K is lower.
- The Sinclair is now much more expensive than the other two 15K RAM packs and is not as neat. It also emits an annoying buzzing sound from its 3.5in. by 3.5in. by 2in. case.
- The 32K RAM from Audio Computers is available in kit or ready-assembled form, but requires an extra +12V power supply. It has a very good amount of detail, but its edge connector detracts from any good qualities it might have. The 128K RAM pack by the same company has problems as only 32K can be used at one time.
- The Memotech pack gives a full 48K of Basic memory — with certain restrictions. It will be useful for large databases as long as precautions are taken about overheating during long periods of use. There is also a 15 percent educational discount available.

NOW IN STOCK

THE NEW & EXCITING TRS80 MODEL III



EXTENDED GUARANTEE BY COMPUCARE

48K **£599** + 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

EXTENDED GUARANTEE BY COMPUCARE

HITACHI PROFESSIONAL MONITORS

9" — ~~£129~~ **£99.95**
12" — ~~£199~~ **£149**
} + VAT

● **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.

NEW

ACORN ATOM

UNIQUE IN CONCEPT — THE HOME COMPUTER THAT GROWS AS YOU DO

Fully Assembled **£157.50** + VAT **inc. PSU**

EXTENDED GUARANTEE BY COMPUCARE

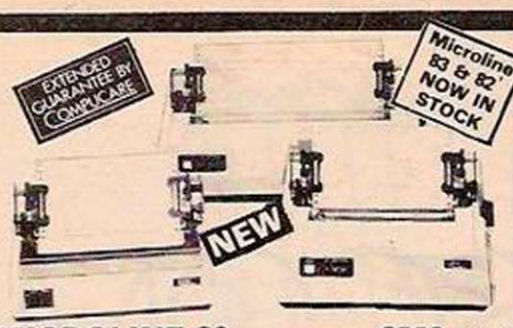
Special features include ● Full Sized Keyboard ● Assembler and Basic ● Top Quality Moulded Case ● Optional High Resolution Colour Graphics ● 6502 Microprocessor

THE EPSON MX SERIES

EXTENDED GUARANTEE BY COMPUCARE

- 80/132 Column
- Centronics Parallel
- Bi-directional
- Upper & lower case
- True Descenders
- 9x9 Dot Matrix
- Condensed and Enlarged Characters
- Interfaces and Ribbons available

MX80T £339 + VAT
MX80F/T £389 + VAT



EXTENDED GUARANTEE BY COMPUCARE

Microline 83 & 82' NOW IN STOCK

NEW

MICROLINE 80 £289 + 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

INTRODUCING THE NEW SHARP MZ-80B

NEW

EXTENDED GUARANTEE BY COMPUCARE

£999 + VAT.

● 4 Mhz Z-80 CPU ● Dynamic RAM ● 2K ROM ● BASIC is provided ● High Resolution Graphics ● 9" High Focus Green Display ● Upper and Lower Case ● 80/40 Characters x 25 line display ● Electro Magnetic Cassette Deck included ● ASC11 Keyboard ● Numeric Keypad ● Sound Output ● Built-in Clock and Music.

Available Soon-Discs, Printers and other Accessories.

DUE TO IMMENSE POPULARITY SALE CONTINUED

EUROPE'S FASTEST SELLING ONE BOARD COMPUTER

COMPUKIT UK101

★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.

KIT ONLY **£99.95** + VAT
Fully Assembled — **£149** + VAT
} PLUS **£4.60** Post & Packing

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.

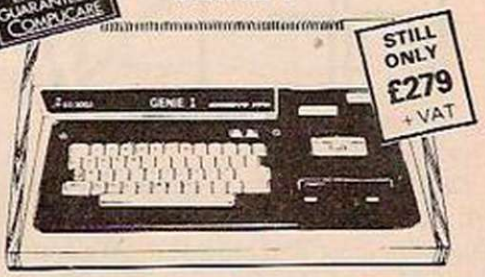
INTRODUCING THE NEW GENIE

Ideal for small businesses, schools, colleges, homes, etc. Suitable for the experienced, inexperienced, hobbyist, teacher, etc.

GENIE I

EXTENDED GUARANTEE BY COMPUCARE

STILL ONLY **£279** + VAT



NOW **INCLUDED:** Sound, Upper and lower case, Extended BASIC and Machine Code enabling the Writing and Execution of Machine Codes Programming direct from Keyboard.
16K RAM. 12K Microsoft BASIC
Extensive Software Range.
Self-Contained PSU UHF Modulator Cassette. External Cassette Interface. Simply plugs into TV or Monitor. Complete and Ready to Go. Display is 6 lines by 32 or 64 Characters Switchable. 3 Mannuals included, Users Guide, Beginners Programming and BASIC Reference Mannual. BASIC Program Tape Supplied. Pixel Graphics.

GENIE II

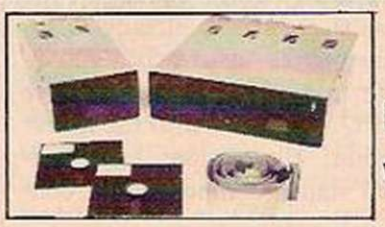
EXTENDED GUARANTEE BY COMPUCARE

£299 + VAT

The **NEW GENIE II** an ideal Business Machine. 13K Microsoft BASIC in ROM. 71 Keyboard. Numeric Keypad. Upper & Lower Case. Standard Flashing Cursor. Cassette Interface 16K RAM Expanded externally to 48K.

GENIE I & II EXPANSION UNIT WITH 32K RAM £199 + VAT.

PARALLEL PRINTER INTERFACE CARD
£35.00 + VAT



TEAC DISK DRIVES

EXTENDED GUARANTEE BY COMPUCARE

- TEAC FD-50A has 40 tracks giving 125K Bytes unformatted single density capacity.
- The FD-50A can be used in double density recording mode.
- The FD-50A is Shugart SA400 interface compatible.
- Directly compatible with Tandy TRS80 expansion interface.
- Also interfaces with Video Genie, SWTP, TRS80, North Star Horizon, Superbrain, Nascom, etc, etc.
- Address selection for Daisy chaining up to 4 Disks.
- Disks plus power supply housed in an attractive grey case.

40 TRACK
Single Disk Drive **£225** + VAT — Double Disk Drive **£389** + VAT

77 TRACK
Single Disk Drive **£299** + VAT — Double Disk Drive **£499** + VAT

COMP SHOP

"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
✸ **IRELAND:** 19 Herbert Street, Dublin 2. Telephone Dublin 604165

TELEPHONE SALES
OPEN 24 hrs. 7 days a week
01-449 6596

BARCLAYCARD VISA · AMERICAN EXPRESS · DINERS CLUB INTERNATIONAL · We welcome Access

REVIEW

THE NASCOM RANGE

The Nascom family includes not only the well-known models 1 and 2 but also a host of peripherals and software. Malcolm Bell evaluates the range.

THE ORIGINAL Nascom 1 system has had a facelift and is still alive and looking good, although for most domestic and development purposes it has been superseded by the Nascom 2. At a kit price of £125 plus VAT, the Nascom 1 is very good value for money — it offers a full ASCII keyboard of excellent quality, UHF/monitor output in 16 lines by 48 character format, and serial output port for mass storage of programs and/or data via cassette or printer.

It is a single-board design based around the successful Zilog Z-80 CPU and operates at 2MHz. On board it supports the NasSys 2K monitor and 1K memory-mapped VDU RAM. An empty socket is provided for a 16-bit programmable input/output port. The system is fully expandable up to 64K memory if a buffer board is used. All manner of peripherals can be connected either to the dedicated ports or the 77-way bus.

Flexibility first

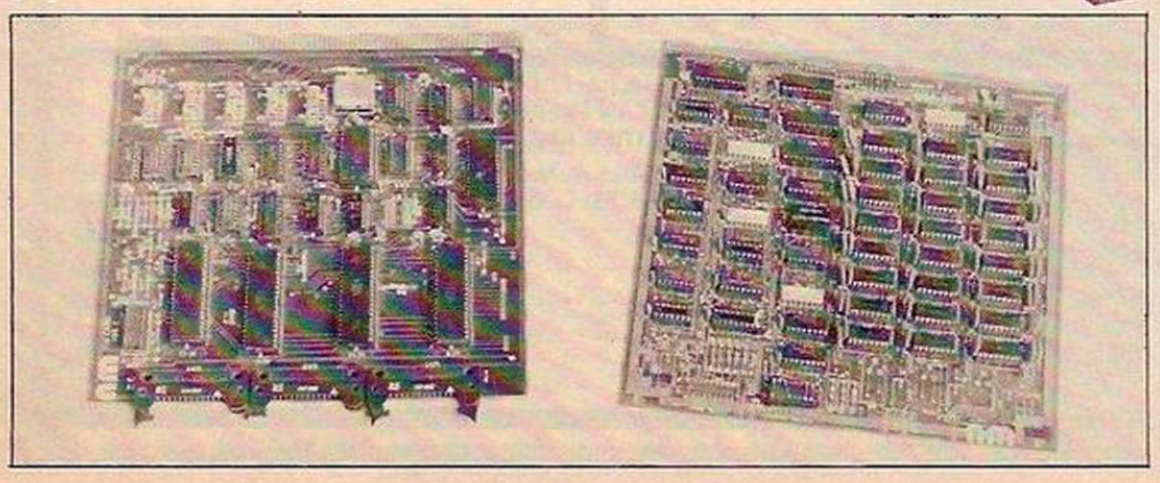
The 900 bytes of user RAM provided is only really adequate for learning purposes or applications such as burglar alarms, control, robotics etc., so expansion is eventually necessary. With the expansion boards, the system will support all the software available.

The Nascom 2 is now the mainstay of the range and follows the practices already established by the Nascom 1. Again it is a single-board system but upgraded to use the faster 4MHz Z-80A CPU. Designed with the fullest flexibility in mind, the system can communicate with all standard input/output configurations.

A kit version is available for £225 plus VAT but is strictly for the advanced constructor. A ready-built version costs £265 plus VAT. Both versions are supplied with the 2K NasSys monitor and 8K Basic in ROM as standard, and provision is made on-board for a further 8K of static RAM or EPROM which can be located at any of the 4K address boundaries.

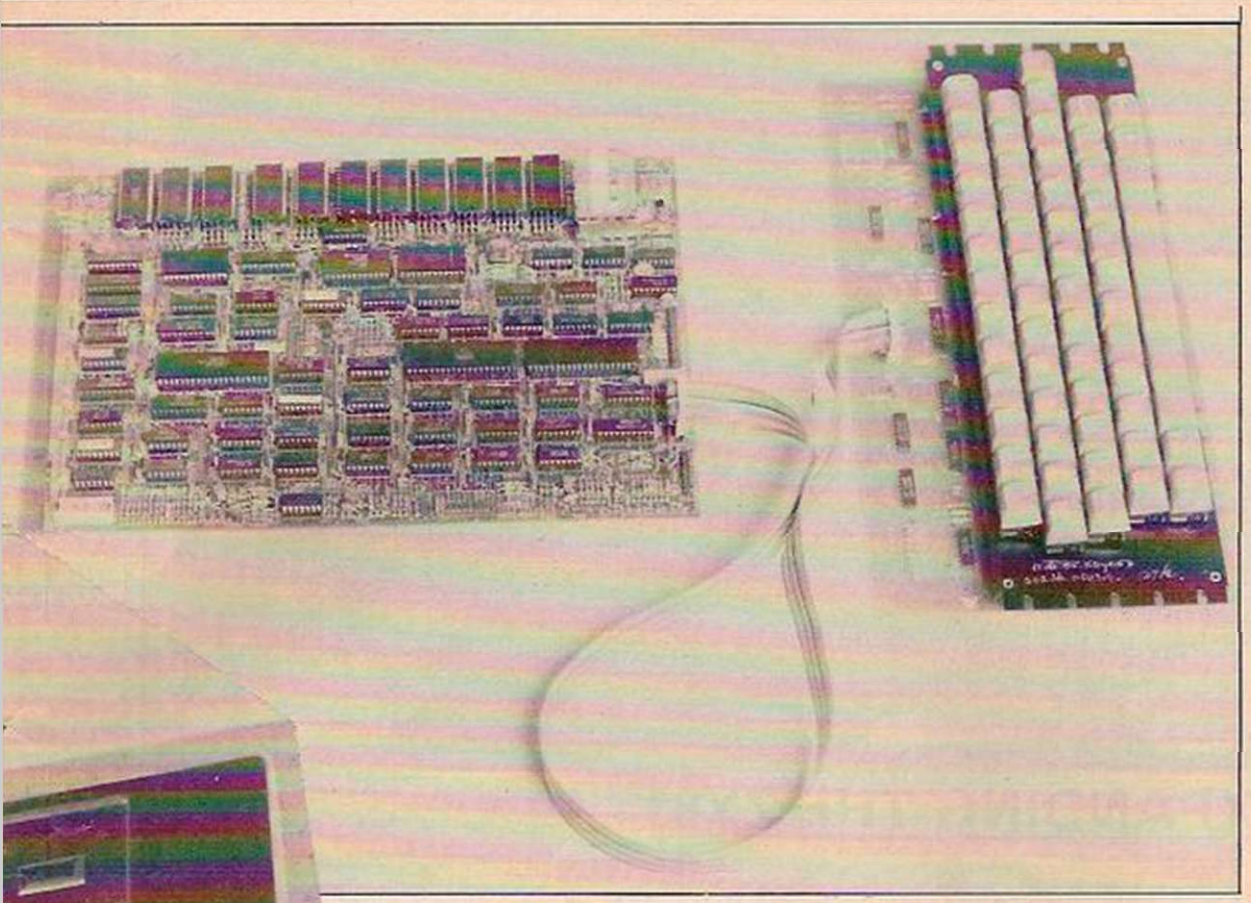
A socket also exists for a 128-character graphics ROM. A 16-bit programmable input/output port is supplied as standard in the on-board socket and additional ports can be added on the PI/O board. Again, the VDU is fully supported, and the cassette tape and printer interfaces are provided.

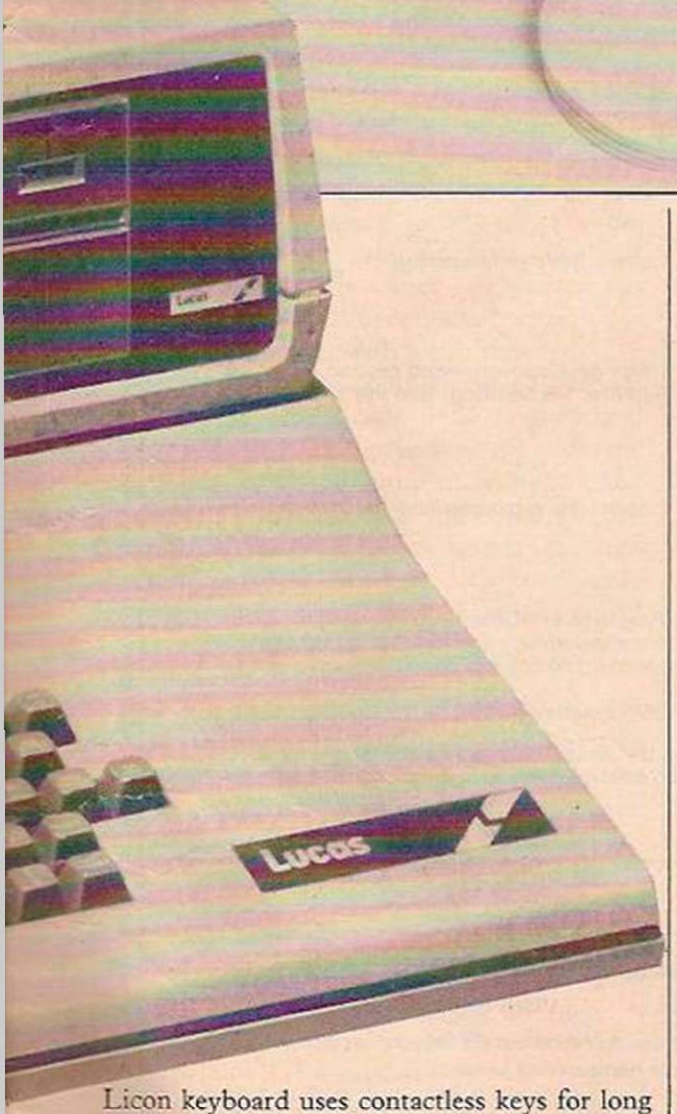
The original Nascom, below, was superseded in late 1979 by the launch of the Nascom 2, top right. Last year, under new management, the model 3, an enhanced Nascom 2, hit the market.



The display is 16 lines by 48 characters as for the Nascom 1 — this is probably the biggest factor in Nascom's lack of success in the business-machine market. The quality of the display on a standard TV set is acceptable although a slight wobble is experienced from time to time on some systems.

The 77-way bus is fully buffered and expansion is facilitated by the add-on boards. The





Licon keyboard uses contactless keys for long life and they are less easily damaged by the heavy-handed user or children.

In all, this system still represents good value for money and can be expanded into a full-size and powerful computer as your finances permit. There are, as always, a few operational problems but they are mostly confined to the software and are gradually being solved. The board and components have proved, however, to be robust and reliable.

More than adequate

The documentation for building and operating the system is comprehensive and includes extracts from the manufacturer's handbooks for both software and hardware.

The power board provides +12V, −12V, +5V and −5V rails. The +5V rail is rated at 3A which is more than adequate for the main board and up to four additional boards, but leaves little spare to power peripherals. As a kit, it costs £32.50 plus VAT and is simple to build. It has proved reliable although it generates a considerable amount of heat. Neither system includes the power board in its price so this is another initial expense.

The RAM expansion board has been upgraded and is now known as Series B. It can accommodate 48K of dynamic RAM running at the full 4MHz and is completely buffered. As an optional extra, the board can be equipped for page-mode operation allowing addressable memory in excess of 64K. The board can be bought with 16K memory for £80 plus VAT, and further memory added for £15 plus VAT per 16K.

The I/O board is essential if the system is to communicate to any great extent with real-time peripherals. It can accommodate up to six eight-bit parallel ports, one serial port, and a counter/timer unit. For the £45 plus VAT you are only buying the board and the support circuitry — the main devices are extra.

Nascom does not market a system case, although the Kenilworth Case is approved. The company does, however, sell a frame manufactured for its machines by Vero and costing £25 plus VAT. It satisfies the need for a permanent housing for the boards but is rather large and not very attractive.

The Imp printer was one of the first of the small printers to reach the market and it represented excellent value. Yet since this market has changed so rapidly, the Imp is no longer to the fore.

The NasSys 1 monitor is a very powerful program supplied in a 2K ROM to be located at memory address 0H. It is now provided as standard on Nascom 1 and 2 so software for either system is now compatible. The program has been constructed to provide the necessary support for the usual input/output formats, has a very comprehensive program editing and debugging section while at the same time makes its own internal subroutines available for use by the user programs.

Background

Since the inception of the Nascom range of systems in 1977, the fame and fortunes of the controlling company have been volatile. When launched on November 27, 1977 the Nascom 1 was hailed as years ahead of its rivals, and so it was — or at least should have been. In reality, it had not been developed to its full capabilities and did not appear on the market for some time. The demand was aggressively stimulated and the 1,000 systems per year figure grew to 15,000.

The launch of the Nascom 2 system was intended to overcome the problems but a world shortage of 1K static RAM packages only frustrated the company still further. The inevitable cash-flow problems worsened, and eventually the receiver was called in.

Following a long period of uncertainty, Alteck Ltd made a takeover bid which eventually fell through. Now Lucas Logic has given the Nascom range a new lease of life.

What has emerged from this turbulent history is both the success and the popularity of the systems, which have managed to maintain their sale figures throughout. Credit for this must go to the designers of the system and the main suppliers.

The eight restarts are used for reset, character input, relative call, subroutine call of internal subroutines, break-point, string output, character output and delay. You can also modify the main keyboard table and system defaults to make the operating system more flexible.

This monitor has been in use now for several years and has proved very successful. Again, the documentation is of an acceptable standard — the biggest advantage is the inclusion of the full assembly listing. This is both informative and instructive. A full list of monitor commands is given in table 1.

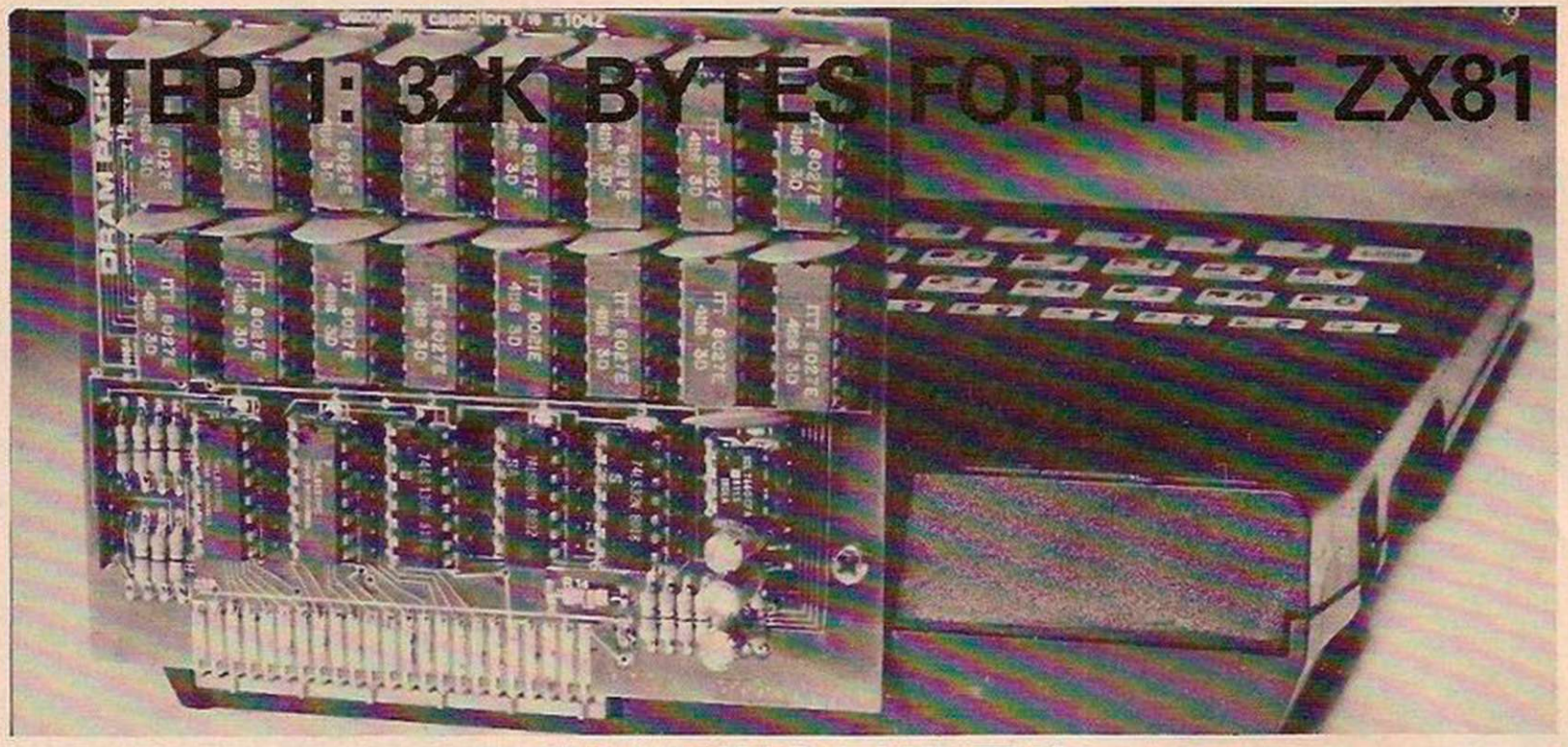
Compatible monitors

The NasSys 3 monitor is an upgraded version of the NasSys 1. Two known bugs which were present on the NasSys 1 have been removed and several interesting new facilities are included. It will eventually become the standard, but at £25 I question whether the extra facilities warrant the expense of changing. The NasSys 3 is downwards-compatible with the NasSys 1 with the exception that the paper tape input command, L, has been dispensed with.

There are three new commands P, D and Y for displaying the user-program registers, execution from 0D000H, and execution from 0B000H respectively. In addition, the Tabulate command has been improved to display hexadecimal and ASCII values, the External command, X, has additional options, and the input command, Read, now has the option of reading with an offset value. An additional feature gives keyboard repeat with adjustable blink rate of the cursor.

The Nascom Basic is provided as standard on the Nascom 2 in ROM and can be purchased separately in ROM or on tape for the Nascom 1. It is an 8K package and a derivative of the widely-used Microsoft Basic, but because it makes extensive use of the internal subroutines of the NasSys monitor, it is comparable with most 12K Basics. Table 2 shows

(continued on page 23)



EXPANDING THE ZX81

Kit	Ready built		
£46.00	£54.00	**STEP 1** Add 32K bytes of Ram with the DRAM PACK, as illustrated above.	Current Basic programming.
£28.00	£34.00	**STEP 2** Add EXTENSION BOARD: 6K bytes of CMOS Ram, 2K byes of EPROM, fitted under the keyboard.	Utility development, word processing, graphic routines, file handling, turn key system.
£10.00	Not available	**STEP 3** Add MOTHERBOARD: 5 extra 2×23 way slots with extra 5V regulator and heatsink.	Extends the expansion port IN/OUT functions.
£12.00	Not available	**STEP 4** Add PARALLEL BOARD: Contains EPROM Programmer, standard ASC11 Printer Driver, 3×8 bit parallel ports.	Programs EPROMs, reads/writes programs from electronic cassettes, word processing on standard 80 column printer.

STEP 5: Library of electronic cassettes: 16K CMOS cassette £44.00; 16K EPROM cassette £30.00

ALTERNATIVE: We produce a special DRAM PACK called SUPER Z which contains 64K bytes of DRAM using the newest memory device (single 5V supply), a peripheral interface adapter offering Eprom programming capability and 3×8 bit parallel ports. The card can also load and save programs and data onto electronic cassettes.

PRICE OF THE SUPER Z = £79.50.

ORDER FORM

Dear Audio Computers,

☐ I am a ZX81 user,

☐ Please send me more technical details of your products.

☐ Please send me the items circled above.

☐ I am using a: (please tick)

☐ Acorn Atom ☐ Pet Series ☐ UK 101 ☐ 6502 OS1

☐ TRS 80 model level ☐ Video Genie model

☐ Please send me more technical details on your products.

☐ Please send me the items circled below:

	Z80A based		6502 based	
	Kit	*Ready built*	*Kit*	*Ready built*
32K bytes Ram expansion	£46.00	£54.00	£59.00	£69.00
64K bytes Ram expansion	–	£79.00	–	£100.00
128K bytes Ram expansion	–	£138.00	–	£150.00
128K bytes Ram array for further expansion	–	£110.00	–	£110.00
16K CMOS Ram expansion	£44	£50	£44	£50
16K Eprom expansion	£30	£36	£30	£36

Prices include VAT at 15% and P&P, full documentation and warranty.

☐ I require a VAT receipt.

☐ I enclose a cheque/postal order payablier to Audio Computers, for £.....

☐ Please charge to my Access/Barclaycard account no. _____

☐ Name: Mr/Mrs _____

☐ Address: _____

Mail (or post) to:

Audio Computers, 87 Bournemouth Park Road, Southend-on-Sea, Essex. Tel: (0702) 613081

(continued from page 21)
the complement of Basic commands. Most worthy of note is the absence of Save and Load commands for string arrays, making file and data handling more time-consuming than normal. There are useful display-manipulation commands and graphic features — Set, Point, and Reset.

The speed of operation of the Basic when used in the Nascom 2 at 4MHz is very impressive — it is twice as fast as the Commodore Pet.

The Zeap Z-80 editor/assembler program is available in EPROM or cassette tape packages — £37 or £25 respectively. It is vital if any program is to be written directly for machine code. It contains an editor to facilitate the entry of programs in the assembler mnemonics of the Z-80 CPU and then translates that listing into machine code.

Crude but useful

The code can be generated directly in memory or can be output to cassette for subsequent reloading. With Zeap, error correction and program modification are greatly simplified, and it includes such features as multiple line deletions, automatic line entry and renumbering. The tape version has a primitive yet useful facility for checking that the assembler program has not been corrupted while the user program was running. For the full benefits you should use Zeap in conjunction with a printer.

The NasDis is the complement of Zeap. It will read the object code of a program and display or print a listing showing the code, the mnemonic, labels all jump-entry points and provides a cross-reference list. Like all disassemblers, it cannot distinguish between program and data, but this does not usually give rise to confusion. The package is supplied in three EPROMs at a cost of £37.50 plus VAT.

The Nas Debug diagnostic package is a 1K package that must be used in conjunction with NasDis. It provides many useful extra features such as the direct register access used in the NasSys 3, dual page mode and direct editing of the assembler listing as the program is stepped through. It is a useful addition at only £15 plus VAT.

Table 1.

A	xxxx yyyy	Arithmetic in hexadecimal
B	xxxx	Break-point set
C	xxxx yyyy zzzz	Copy — move data
E	xxxx	Execute
G	xxxx yyyy zzzz	Generate — write a program to tape including an execution address
H		Half-duplex terminal
I	xxxx yyyy zzzz	Intelligent copy — moves data with overlap protection
J		Basic cold start
K	xx	Set keyboard options
L		Load from paper tape
M	xxxx	Modify data
N		Return to normal I/O
O	xx yy	Output data to a port
Q	xx	Input data from a port
R		Read from a cassette
S	xxx	Single-step through program displaying register status
T	xxxx yyyy zzzz	Tabulate data or write to paper tape
U		User-specified I/O routines
V		Verify data written to cassette
W	xxxx yyyy	Write data to a cassette
X	xx	External serial device control
Z		Basic warm start

Table 2. Nascom Basic.

Commands				
NEW	LIST	CONT	MONITOR	RUN
CLEAR	NULL		LINES	WIDTH
Statements				
DEF	DIM	REM	WAIT	END
POKE	DOKE	DEEK	PEEK	STOP
IF..THEN	IF..GOTO	ON..GOTO	ON..GOSUB	GOTO
SET	RESET	GOSUB	RETURN	FOR
POINT	LET	USR	TAB	SPC
		NEXT		
Input/Output				
PRINT	DATA	INPUT	READ	CLS
INP	OUT	SCREEN	RESTORE	
Operators				
=	–	+	×	
<>	<	>	=<,<=	=>,>=
NOT	AND	OR		
Arithmetic functions				
ABS	ATN	LOG	SIN	INT
SGN	TAN	COS	POS	RND
	SQR	EXP	FRE	
String functions				
ASC	CHR$	STR$	RIGHT$	LEFT$
LEN	MID$	VAL		
Cassette input/output functions				
CSAVE	CLOAD	CLOAD?		
	CSAVE*	CLOAD*		

Word processing is a complicated field and the operating programs are usually very large. So, when considering the Naspen word processor, its size of just 2K must be taken into account. There is no doubt that the facilities it offers are of great value when documenting software, and can be used successfully for letters. However, the commands offered correspond more closely to those found on an editor than on a word processor. Pagination is catered for and page-width or page-length settings can be adjusted, although Naspen does not actually form the text into pages. It is, nevertheless, a useful and recommended program worth every penny of its £30 price.

The Kenilworth case is made from hardwood and steel and is designed for the Nascom 2. It accommodates the main system, power supply and keyboard. By adding support kits, up to five additional expansion boards can be included, which should be adequate for the needs of most users. It is reasonably pleasing in appearance although not up to professional users' standards. The TV or monitor can stand on the case's upper surface and all external connections are made at the rear. Priced at £49.50 for the basic unit and a further £7.50 for the two-board expansion, it is not cheap but does make a compact and practical unit.

The design of both systems leaves the cassette-input and the keyboard port open for all system input conditions. This can give rise to spurious characters from the tape or error entries. The £17.50 Castle Interface provides a more sophisticated tape-handling mechanism, motor control and printer/cassette switching. While not in any way essential, it provides a useful function.

Different versions of the program exist for the two monitors but the functions offered are identical. Both are priced the same at £28 for two EPROMs. Their main use is for entering and editing Basic programs, but they can be used for the main system control if the system reset address is set to its start location.

The functions provided are as follows:

APPEND	Add other basic programs
AUTO LINE NUMBERING	with initial and step variables
DELETE	Single line or block delete
DUMP	Prints to screen all user variables but not arrays
FIND	Finds and displays a specified string
HELP	Displays for modification a specified line — with compression if required
HEX	Hexadecimal to decimal conversion
INKEY	Input from keyboard
RINK	Input from keyboard
MONITOR	Passes control to NasSys
RENUM	with initial and step as variables
STEP	Single-step through a program displaying requested variables

It is a very powerful aid and is strongly recommended.

The Henry's Radio Basic Programmers' Aid is supplied only on tape at £13 and combines some of the features mentioned with the addition of cross-referencing. Screenplus is marketed at £40 and connects to one of the eight-bit ports to produce an enhanced VDU display with reverse-video options for character, word or screen blocks in addition to screen blanking. For that price the user must want those facilities very badly.

The Sargon chess pack costs £35 and includes a manual, chess-graphics board with dedicated ROM and the program on cassette. The documentation for the soundbox programmable sound generator suggests that music can be programmed in Basic into this unit where it is fed to a three-sound channel, dedicated music chip. Then it is passed to the on-board power amplifier and 3in. loudspeaker, or home stereo. It is good value at £39.50. The Arfon speech board is for the man who wants everything. This speech board uses Digitalker and can be connected to the Nascom for £85.

There is a wide range of non-approved products — the most notable being the Gemini 5.25in. double-sided, single-density floppy-disc unit sold by the suppliers for about £450.

CONCLUSIONS

- Despite its chequered career, the Nascom range still has much to offer and its price is compatible with its main competitors.
- A dual-drive, double-density, double-sided, floppy-disc unit with NasSys-compatible control is to be introduced.
- CP/M will also be available.
- For the business market, an advanced video card is to be released which will give 24 lines of 80 columns, high-resolution graphics and colour. It will cost about £120. ■

INTERVIEW

BEHIND THE

Producer Paul Kriwaczek is the man in charge of bringing microcomputing to our TV screens. Brendon Gore visited him at the BBC studios, and together they delved behind the scenes of *The Computer Programme* to examine the original series concepts and how those ideas were put into effect.

PAUL KRIWACZEK HAS the distinction of being the only practising dentist to run a night-club in Kabul, Afghanistan's capital — a fact which should lead you to conclude that he has had a very varied career for a television producer. Born in Vienna, he arrived in England at an early age and was educated at Kilburn Grammar School and Queen Mary College, University of London. He qualified as a dentist at the London Hospital medical college and practised for six years in various parts of England, Afghanistan and Africa.

As for his stint as night-club proprietor, he says: "I was travelling with a friend who was a superb pianist — I played alto sax and flute — and we met two Americans, a base player/singer and a drummer. We formed a group and won sponsorship from the U.S. Information Service. There was no night-club in Kabul at the time, so we set one up at the Khyber restaurant with our group providing the music". It was, says Paul Kriwaczek, tremendous fun.

After leaving Afghanistan, he returned to England briefly and then went to Africa to practise dentistry as a locum. However, for various personal reasons, Paul Kriwaczek decided it was about time he changed his profession. In 1968 he joined the BBC as a script writer for the overseas radio service in Bush House.

He gained experience as a radio producer, and started working in the television science features department. Finally, he moved to the continuing education in televison department where he became involved with *The Computer Programme.*

"*The Computer Programme* series originated about four years ago with the realisation that the microelectronics field was a very important one and that we, as an educational department, really ought to be taking a major lead", says Kriwaczek. "The end result was the rapid production of four or five programmes called *The Silicon Factor* which was an interim holding effort, as it were, looking in general at developments in microelectronics.

"David Allen, who produced *The Silicon Factor* and rapidly became the department's microelectronics expert, then made another series called *Managing the Micro* which was specifically intended for managers.

"But between the original decision to become involved in microelectronics and the end of making *Managing the Micro,* there had been a revolution in the price of personal computers. Given the availability of the microcomputer, it seemed appropriate to start a series which aimed at a wider audience".

Paul Kriwaczek was asked to produce a new series which was to explain computers to the layman. He spent a year learning everything he could about computers, even to the extent of buying and programming a Nascom 2. This research not only turned Kriwaczek into a microcomputer enthusiast, it also convinced him that if the project were to be attempted at all, it had to be more than just another television series.

The BBC Microcomputer is a separate operation to *The Computer Programme* — a fact stressed by Paul Kriwaczek — but the one necessitated the other. It was almost impossible for the BBC not to become involved in marketing hardware once it had decided to become a major software publisher, explains Kriwaczek. "At the very beginning, all our advisors told us it was absolutely necessary that an organisation with the standing and public confidence of the BBC should enter the business of computer software, but software for what"?

Kriwaczek admits that the BBC Microcomputer is not a cheap machine: "But then a colour television is not cheap either, nor is a stereo system, and we are talking about commensurate kinds of prices. I would have been very reluctant for the BBC to sell something like the Sinclair because it is so limited. The Sinclair cannot be expanded; it is fundamentally a throw-away consumer product. Its usefulness is in learning about programming, but I do not believe that the future of computers lies in everyone learning to program in Basic.

"The BBC Microcomputer is expensive, but it's still the best value for money on the market. It has graphics which no other microcomputer possesses, and it has a Basic which gives you as much flexibility as you could want from the language. A 32-bit processor, which is in the design stage at the moment, will make it possible to expand the BBC Microcomputer into the most powerful business system you could wish for".

The Computer Programme, however, is not designed to sing the praises of any one computer — not even the BBC's. It is more concerned to explain how computers work, the ideas that lie behind them and the applications to which they are being put. *The Computer Programme* is essentially an introduction for the unitiated. "What I hope the programme will do", says Kriwaczek, "is to show people first of all that computing is not difficult to understand; secondly, to alert them to some of the things that are going to be happening to them in their lives as a result; and thirdly, to suggest that the way in which computers work may be a useful way of looking at things".

Yet Kriwaczek's hopes for the programme have been affected by the decision to show it at off-peak viewing times. The first programme in the series was transmitted on BBC2 on Monday, January 11, at 3.05pm. It was repeated on BBC1 on Sunday, February 14 at 10.10am and is due to be shown again on BBC1 on Monday, March 22, at 11.35pm.

"My brief was to produce a popular programme for the layman. That's what I was asked to do — it wasn't my decision. I therefore expected that it would be transmitted at such a time when the layman would be watching. None of the transmission slots that we have at the moment seems to me to satisfy that definition. If I had thought that we would be restricted to what necessarily will be a minority audience, I would probably have made an entirely different series".

The series that Kriwaczek has made was determined not just by its intended audience, but also by the subject matter and by external circumstances. Kriwaczek was given 10 25-minute programmes for the series. Given that limitation, he had to decide whether to make a sequential series with programme 2 starting where programme 1 ends, or whether to devote each programme to a single idea.

'TV production is part art and part pure accident'

"We know that people do not watch the whole of a series", he says. "We know that only about 50 percent of the people who watch programme 4 of a series will have watched programme 3 and only about 50 percent of those are going to go on and watch programme 5.

BBC PROGRAMMES

You cannot guarantee that your audience will have seen any other programme, so each programme has to stand alone.

"As the subject area you can cover in 25 minutes is limited, and the number of different principles in computing is not actually that great, the best idea is probably to devote each programme to a separate principle or concept. But if the series is just about principles and concepts it will be boring, so you divide the series in half with the first part dealing with fundamental principles and the second part looking at various applications.

"Then you say to yourself, hang on a moment, we ought to make programme 1 a general introduction to the whole area so people know what's going on. If we do that, we should make the last programme a kind of pull-together of all our other ideas about how society is to be affected by this revolution we are seeing around us. So that gets rid of programmes 1 and 10. Programmes 2 to 5 deal with basic principles and programmes 6 to 9 cover applications — and that's how you decide how to do the series. Your decisions are really forced on you".

Choosing presenters for the series was not an easy task. Kriwaczek was looking for three people, a computer expert, a lady reporter and a representative layman. Chris Serle, who had worked for the education department before moving on to *That's Life*, was an obvious choice for the representative layman, but the other two presenters were much harder to find.

'The ZX-81 is a throw-away consumer product'

By chance, David Bellamy, who had been working with Kriwaczek on *Backyard Safari*, suggested contacting Ian McNaught Davis, European head of Comshare. "McNaught Davis came to a meeting in this office", says Kriwaczek, "and I showed him the pilot programme we had already made for the series. He instantly sold himself to us because he was just so obviously very good".

The lady reporter was found simply by seeing a good deal of would-be lady reporters. After lengthy discussions and trying some of them on film, the choice fell to Gill Neville.

Producing any television series, let alone *The Computer Programme*, is a difficult undertaking. Paul Kriwaczek is concerned with all aspects of the programme from film editing to the minutiae of deciding whether or not to have potted plants on the set.

He is also responsible for managing the entire team of directors, presenters and assistant producers and trying to get the best out of them. Television production is part art, part craft, part experience and part pure accident, he concludes.

"You must have a feel for structure and form just as you have with writing anything, because television is a narrative form. When you write an article you are trying to lead people gently from one idea to the next without making them think suddenly 'Hey, how did we arrive here?'

"You are trying to make them read the article without being conscious of having read it. Equally, the art of making a good television programme is to give people something to watch that will interest and entertain them without making them aware of having to sit through it".

A follow-up series to *The Computer Programme* is likely but it is still too early to say what form it will take. "It will probably be a much more particular series about the use of the microcomputer at home", says Kriwaczek. "David Allen will be producing it, but more than that I do not know".

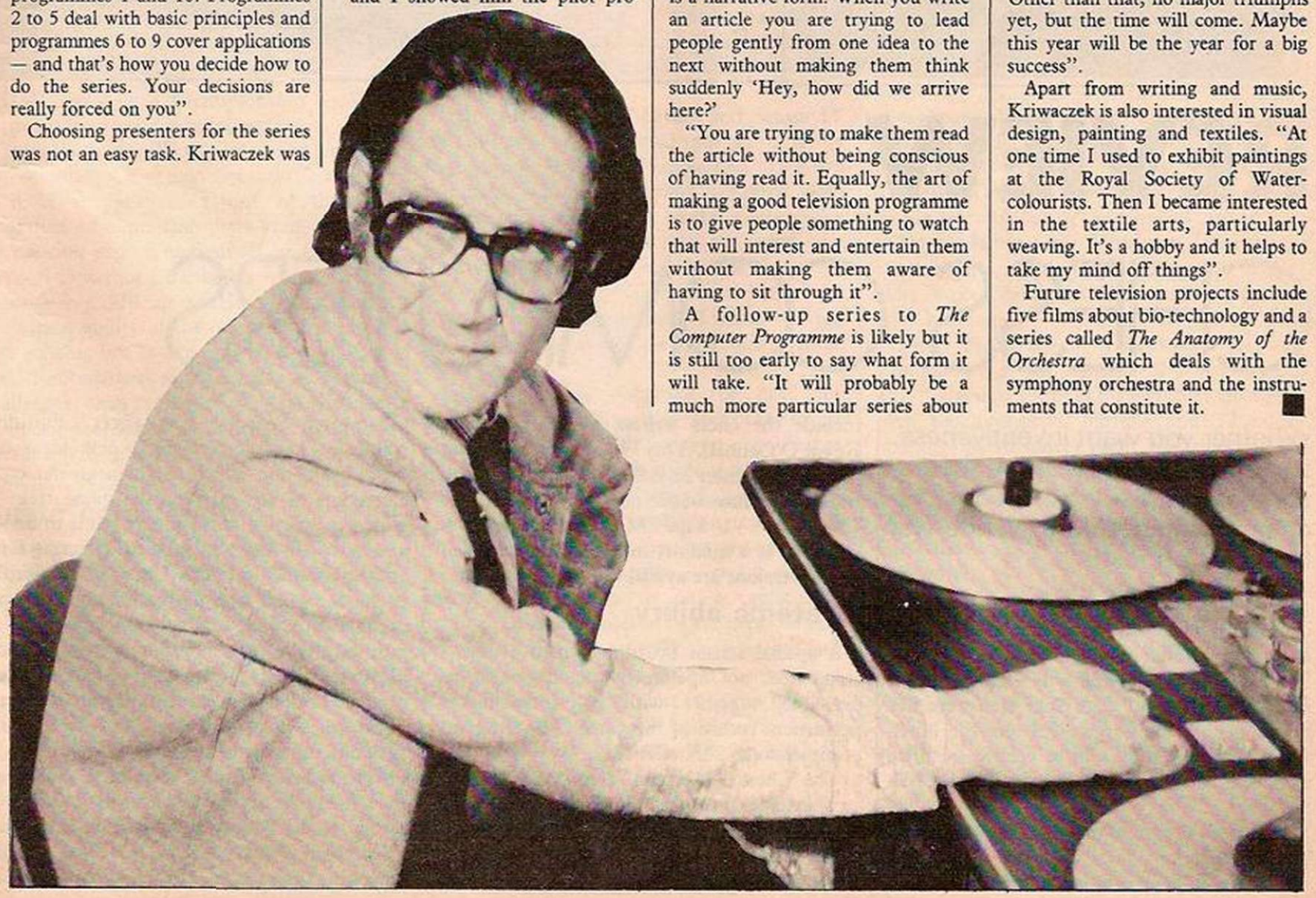
Kriwaczek plans to take a month's holiday in Devon once *The Computer Programme* is completed. Not that he will simply be puting his feet up — he has a few short stories to write and a film script to work on.

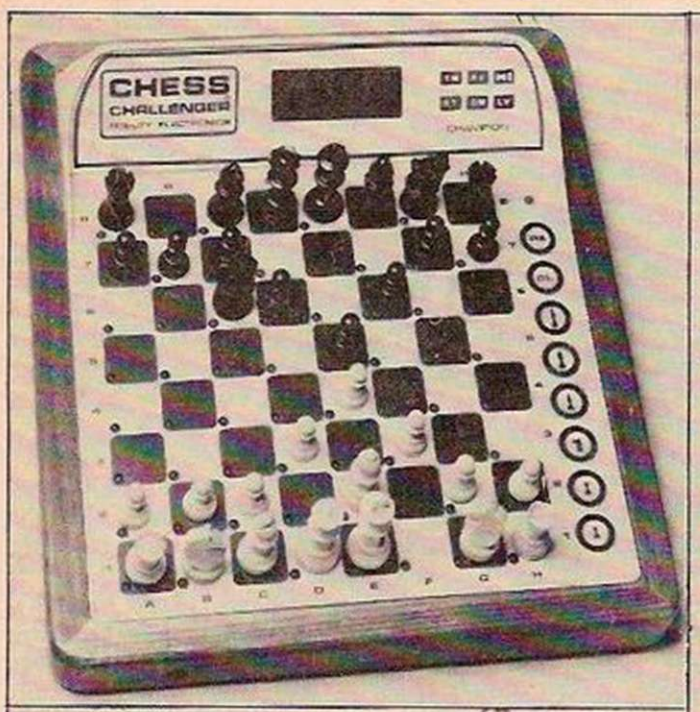
"I write a good deal, both for radio and the stage. My biggest success, so far, is the fact that my adaptation of Brecht's *Fears and Miseries of the Third Reich* has been accepted as the standard one which everybody plays. Other than that, no major triumphs yet, but the time will come. Maybe this year will be the year for a big success".

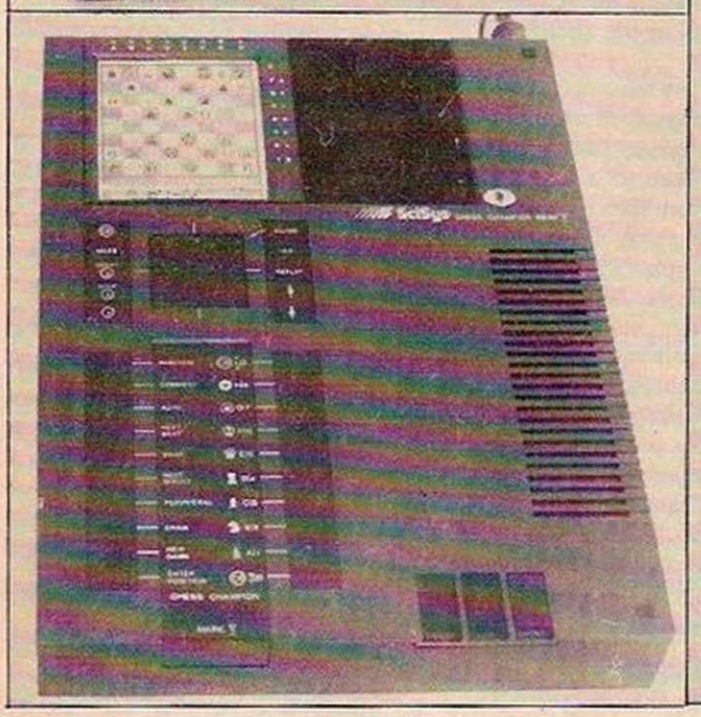
'Computing is not difficult to understand'

Apart from writing and music, Kriwaczek is also interested in visual design, painting and textiles. "At one time I used to exhibit paintings at the Royal Society of Watercolourists. Then I became interested in the textile arts, particularly weaving. It's a hobby and it helps to take my mind off things".

Future television projects include five films about bio-technology and a series called *The Anatomy of the Orchestra* which deals with the symphony orchestra and the instruments that constitute it. ■







REVIEW

CHESS COMPUTERS

Whether you want inventiveness, strong positional play or sheer tactical virtuosity from your chess machine, John White will help you choose.

THE APPLIED Concepts Sargon and the Challenger programs from Fidelity have always shared a similar style, even before the Spracklen husband-and-wife team joined Fidelity — Dan and Kate Spracklen were the brains behind the Sargon 2.5. On the other hand, different minds have clearly been at work for the Hong Kong-based company Sci-Sys.

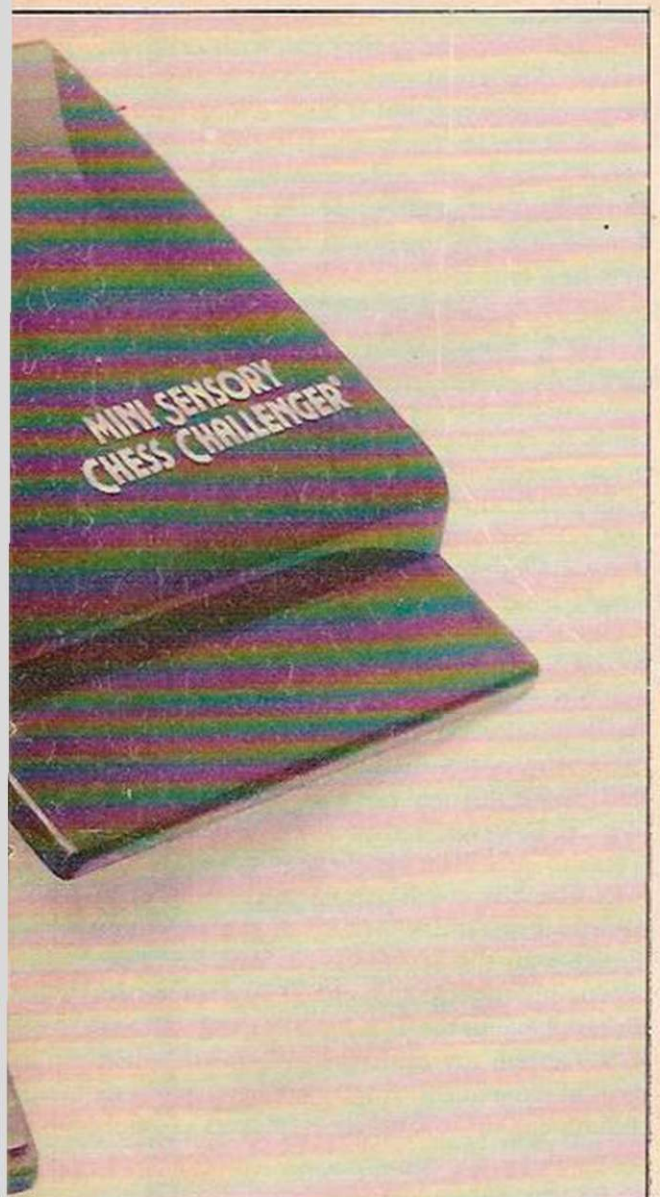
The best program to run in the Sci-Sys Chess Champion V was created by the U.K. software company Philidor whose directors include the chess writers David Levy and Kevin O'Connell. This Philidor program was originally written in Z-80 code, but has been translated into 6502 code for the Chess Champion V. Like Morphy, Philidor is supplied as a module, to be exchanged when better versions are available.

Strategic ability

A special sensor board — which I understand does not operate by touch — will be available, together with a printer for a permanent record of the game. The program occupies some 24K of ROM.

The Chess Champion V recognises draws by stalemate, three-fold repetition or under the 50-move rule. Interestingly, it will also give its assessment of a position and offer or accept a draw accordingly. Unlike Morphy and Champion Sensory Challenger, Philidor claims to have implemented new ideas on move evaluation which result in greater consideration of any part of the game tree — which is what a human player tends to do — and new, still-secret methods of effecting fast, strategic evaluation. The Chess Champion V is claimed to be the first machine of any type capable of making strategic assessments of a position, as opposed to purely tactical considerations. If is, therefore, the first computer capable of forming comparatively long-term plans, the lack of which has plagued all previous commercial models.

Extraordinary claims have been made for the Chess Champion V; that its play exceeds a rating of ELO 1,900 or BCF 163, at an unspecified level. It has also done well against other chess computers — it won the September



1981 World Micro Championship in West Germany in the commercial section.

Chess Champion V plays at as fast a pace as the Sargon or Champion Sensory Challenger — it is unquestionably one of the new generation of super-fast chess computers. In the position shown in figure 1, it found the move a6-c5 within 1.5 minutes — an excellent response in a difficult position. It also retains the tactical ability of the other machines to a large extent, but is not so brilliant at high-speed combinations as the Champion Sensory Challenger, or as capable of tying its opponent into positional knots as Morphy. Automatic moves, where only one move is legal, are made at once.

Cursor confirmation

The Chess Champion V possesses a considerable book-opening library from which the opening is randomly selected. Other facilities include the ability to find mate-in-seven problems, to play up to 12 games at once, to retrace moves, to think during its opponent's time and to give prompts to its opponents.

The entire unit has a very pleasing appearance. Moves can be entered by pressing buttons or by a novel method which involves moving a cursor over pieces visible in a built-in, supplied liquid-crystal display board. This provides constant confirmation that you and the machine are thinking about the same move. However, the design of the pieces leaves much to be desired.

As far as I can tell by testing, the Chess Champion V's strategic evaluation consists of advancing pawn masses, either majorities against minorities or against the castled enemy king, and of moving pieces into lines of attack against this king. Evaluation is performed at considerable speed, and is a creditable achievement. Such planning gives the machine an advantage over its fellow chess computers, and its strategic play makes many games look brilliant.

Play a test game

Like other machines the Chess Champion V likes to sacrifice its knights for enemy bishops early in the game. It is also prone to suffering from doubled pawns. The end-game play is interesting. The pawn masses are advanced with considerable skill but the king is perhaps less active than it should be.

Chess Champion V is the most interesting of the major three chess computers, and plays in a style most like that of a human. Its many user features are well conceived and will have wide appeal. The price of the main unit is £280, and the sensor board will cost some £155.

Those with about £300 to spend should decide whether they want to play against an inventive opponent — Chess Champion V — a positional opponent — Morphy — or a tactical opponent — Champion Sensory Challenger. I should strongly advise you to test your choice before parting with the money.

There are two other very strong chess computers, but neither can be obtained in the U.K. They are the Savant from the Hong Kong-based Novag company, and the Mephisto which has been available in the rest of Europe for some time now without reaching these shores.

The Novag range of Savant and Sensor IV was to have been imported into the U.K. by the importers of Grandstand Leisure products, but the company achieved only limited success with the bottom-of-the-range Novag Microchess, and now the other two may not be imported at all — despite plans for a launch in 1982. The Savant uses the Mychess program, a version of which — rated at ELO 1,615 — is also available for the Apple computer.

Sensory boards eliminate the need for players to key in moves, and three of the major manufacturers have entered the large £50-£100 market with suitable models.

The £55 Sensory Mini Challenger from Fidelity is designed as a travelling companion with pegs for playing pieces, battery operation — AC is an optional extra — and a sensory board. The program is on a replaceable module. Other modules to be released include Advanced Chess, Popular Book Openings and Chess Master Games, as well as checkers and others. The original module includes random selection between moves of equal merit. There are no true book openings, but the machine will give different opening moves.

The Mini Challenger has four levels of play — the fourth is of indefinite duration for problem solving. The third level takes 60 to 100 seconds per move, at which speed the standard of play is surprisingly good for such a low-priced machine. The sensory board also works well. This is an attractive machine, which will demolish most of the others available at this price.

Conceptually similar, Novag's £80 Microchess has a 4K program with seven levels and an eighth, indefinite level which uses iterative deepening. The program is not on a replaceable module. The unit is beautifully built, and the machine also features a memory for storing uncompleted games for up to a week — useful if the train reaches the station too quickly.

Sci-Sys has entered the market with the £80 Sensor Chess, another 4K program with eight levels, a small, randomly-selected book-opening library and a program on a replaceable cartridge. Replacement cartridges include Strong Play, Extra-strong Play and Hypermodern in the chess field.

Sci-Sys has also released Graduate Chess at £35 — a travelling game without a sensory board — and Executive Chess at £90 — a 4K program developed around a large liquid-crystal display device which serves as a pocket

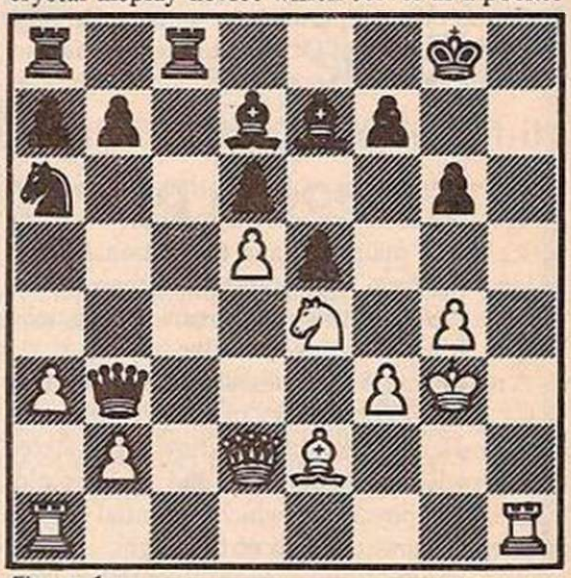


Figure 1.

chess-board. Tandy's £35 Graduate Chess and £50 Chess Machine appear to be replicas of the Sci-Sys Graduate Chess and Chess Traveller; Dixon's Chess Machine also bears a strong resemblance to the Chess Traveller.

The Fidelity £360 Decorator Challenger consists of a slightly-upgraded version of the older Voice Challenger, now in a very decorative housing.

The eight-level Chessmate from Commodore at £60 consists of a stand-alone unit — the user supplies his own chessboard — with touch-sensitive buttons and 32 book openings of 16 moves each. The standard of play is poorer than that of the other newcomers, and on a par with the £60 Boris Diplomat II which replaces the older Diplomat and is designed as a travelling companion.

The £1,500 Boris Handroid contains the Sargon 2.5 program in an amazing device consisting in part of a robot arm, which moves the pieces for you, and a sensory board. Since the improved Morphy program is available in the Encore machine from the same manufacturer at about £180, you will be paying considerably more than £1,000 for the dubious privilege of having a machine make slightly inferior moves, although the Sargon 2.5 is still a very strong program.

(continued on next page)

(continued from previous page)

The £80 Partner 2000 is another Sci-Sys machine with a sensory board but you have to press Enter after making the moves and must read the machine's response from a display. Castling and *en passant* require special attention. This 4K program chooses randomly between a very limited opening library.

Sci-Sys seems determined to flood the lower end of the market with 4K machines, and one must compliment the designers on their achievement in packaging so much into so little. Nevertheless these machines are probably best suited to beginners. In my opinion, Partner 2000 is rather weaker than the older and comparably-priced Chess Challenger 7, although that needs 32K of ROM.

Much better is the new £120 Super System IV, a revised version of the older Super System III. The new model, like the old, has provision for an optional liquid-crystal display board at £75 and a £75 printer, but there is no sensory board. Unlike its predecessor, the System IV has a reasonable book-opening library, 12K of ROM and the program is supplied on an upgradeable module. A very powerful version of Othello, or Reversi, is also available for this machine.

Hi-fi converts

The whole unit, like all the new Sci-Sys range, has a very modern appearance and the price of the main unit and the optional extras is, in each case, significantly less than that of the earlier equivalents. I can recommend Super System IV as good value.

A new name is the Westrak Chess Computer CC1 at £130. This bulky machine is imported by Howland-West, better known for stereo equipment, and has a solid and perhaps old-fashioned appearance which potential buyers will either love or loath at first sight.

The playing pieces each have long jack-plugs protruding to operate the sensory board — a technique which works very well. There are 12 levels in all, of which the first six have response times of between 30 and 60 seconds, and the other six of between nine and 15 minutes. The machine also features plenty of loud beeps.

The CCA possesses no book openings, but the standard of play even at the lowest level is satisfactory — although not as good as the Sensory 8 — and clearly contains some original thinking in the evaluation function. The king does have an unfortunate tendency to wander during the mid-game. Overall, then, it is an unusual and distinctive machine.

A number of new releases have been made in software for personal computers. There are at least three for the Sinclair ZX-80/81 with 16K expansion. Z-Chess and Chessmate 80 have become available for the Tandy TRS-80 and there are several others. Those few which I have seen pay more attention to the quality of their graphics than of the play, and some set a nadir by which to judge all others. At least one employs no look-ahead even at the top level, and kindly formed up all its pieces for my rook to take them.

Software packages

Among four stronger programs held in software, some of which approach the strength of Morphy Champion Sensory Challenger and the Chess Champion V, is Gambiet 80. This program requires 10K for a Tandy TRS-80 and has a good record against other chess computers. It is distributed in the U.K. by MicroTrend. Mychess has a rating of USCF 1,615 — about BCF 127 — and is available for the Apple, but I believe that it can only be purchased in the U.S.A.

PetChess was written by Philidor Software especially for ACT/Microsoft for the Pet 3000, 4000 and 8000 series. My review tape occupied almost the entire memory of a 32K 8032 Pet and, for the first time, I realised the privations of those who have to load tapes at 300 baud, although a disc version is also available.

PetChess is claimed to offer more facilities than any other chess software. Setting up positions is exceptionally easy and so is retracing moves. There is, however, no hint button to tell you what to do on your move. An audio alert is also available for the 8000 series. There are 12 levels of play from five seconds to 40 minutes. The graphics are very easy to understand — by way of a change — and the program seems to be crashproof.

There is a substantial book-opening library of 3,700 moves, although whether a computer should play the dubious von Hennig-Schara gambit is open to doubt. Moves may be taken back to the beginning and an action replay is available to repeat moves.

The program uses iterative deepening for its moves and the best move yet found is constantly displayed, as is the move under consideration, and the player can halt the machine's thinking at any time. Moves are not randomly selected — except in the opening — instead the player can select the next best move and play on from there. Draws under the 50-move rule, stalemate or three-fold repetition are also recognised.

The entire program and its style of play is reminiscent of Philidor's Intelligent Chess, although there is a greater emphasis on pawn moves. The evaluation function is evidently very sophisticated, but it takes a long time to search at the lowest levels. It seems that subsequent levels are only sketchily evaluated, and the program rarely changes its mind about a move found at the lowest level. As a result, PetChess falls into simple traps at these levels — up to one minute, which covers half of the available levels — because of its inability to see far ahead.

At higher levels, it avoids the traps, but tends to exchange everything it can. Like so many programs, it likes to exchange its bishops for knights early in the game, and it also prefers to double its pawns rather than move its queen before castling — I detect Levy's hand.

PetChess shows some evidence of strategic thinking in moving pawn majorities against minorities or in moving major pieces into attack positions against the enemy king. This, again, shows the thought that has been put into the evaluation function. The end-game play is, however, rather weak, and the king seems to be a little passive.

PetChess is not as strong as the Sargon II cassette program, which in any case is not available for the Pet in this country. PetChess is certainly the strongest chess program for the Pet available in the U.K. and is good value at £25. Despite my criticisms, I gained a great deal of enjoyment from PetChess and can recommend it to Pet chess players of club standard.

Old standbys

Artic Computing's £15 ZX Chess II is available for the Sinclair ZX-81 with 16K RAM. There are seven levels, searching up to 12 ply ahead. Level 4 — average response time three minutes per move — considers eight ply ahead. The program occupies some 9K of RAM and incorporates a limited book-opening selection. A larger library and random responses may be added at a later date. The graphics are rudimentary, which I regard as an advantage.

Several TV chess games have become available. These include games for the Interton, Atari and Mattel programmable TV units, and for the new Tandy Colour Computer. I have been unable to steel myself to play these after earlier experiences with the dreadful play and incomprehensible graphics of some of their predecessors. Prices are in the range £15 to £50.

Finally, we must not forget some of the older, but still excellent, chess programs which are available. The Fidelity Sensory 8 is highly commendable at £130 — it is the Challenger 7 with a superb Fidelity sensory board. Although not as fast or as strong as Morphy, Champion Sensory Challenger and the Chess Champion V, it still holds its own against most of the others mentioned in this survey, although it is rather let down by its weak end-game play.

The Sargon II is available on cassette or disc for many home computers at between £15 and £30 and remains one of the most powerful in software. Like all Spracklen-designed games, its end-game play is excellent. ■

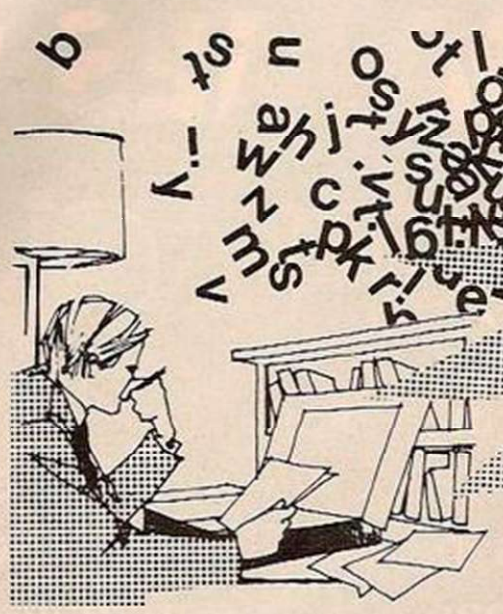
CONCLUSIONS

- The Chess Champion Mark V is an excellent machine where much attention has been made to user extras.
- It exhibits some understanding of strategic play. Its tactical play is weaker than that of the Champion Sensory Challenger at equal response times.
- It is cheaper, at £280, than the other two main competitors.
- I can confidently recommend the machine — but do not expect play equivalent to more than ELO 1,900.
- The £120 Super System IV is good value. The optional extras are also relatively inexpensive.
- Pet Chess at £25 is good value for Pet owners with 32K.
- The latest down-market sensory chess machines all play reasonably well. Of these, the Mini Sensory Challenger is superb value at £55.

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 £1 postage.*

GAMES

MAZE ATTACK

Laser-toting aliens lurk in the deepest recesses of Marcus Altman's maze. But to meet them means that you have already solved the riddle at the heart of the labyrinth.

MAZE ATTACK IS in two parts: the first is an Adventure, the second a space game. The program starts with a random maze where two of your enemies chase you round the labyrinth. The difficulty of the maze and the speed with which the enemy chases you increases with each level.

The idea is to collect three keys which will give you access to the battle room — the second part of the game. These keys are situated behind doors on each level of the maze. The only trouble is that you do not know which door. There could be a monster waiting behind the door you are about to try, or a stairway leading up to a harder level which you have to take. Equally, it might conceal one of the valuable keys.

Once you have the three keys, you automatically gain access to the battle room. Yet if one of the enemy catches you before you find the keys, you die.

Once you are in the battle room, you have four laser bases to control, one at a time. You have to shoot down the invaders who are also firing mercilessly at you. It is just a matter of time until the aliens are victorious.

This program was written in Basic for a Pet and occupies only 3.5K of memory. Only a few subroutines are used because it was found that the 16K Pet ran out of memory after about 15 minutes of continuous play with many subroutines in the program.

With the exclusion of most of the subroutines, the only factor you have to worry about is being blown up by an alien. The program can be converted easily to other machines that have memory-mapped screens and I will explain each individual Poke, Peek and Sys.

Lines 2-3: B equals the number of squares in the maze, F equals the probability of enemy moving — 1:7.

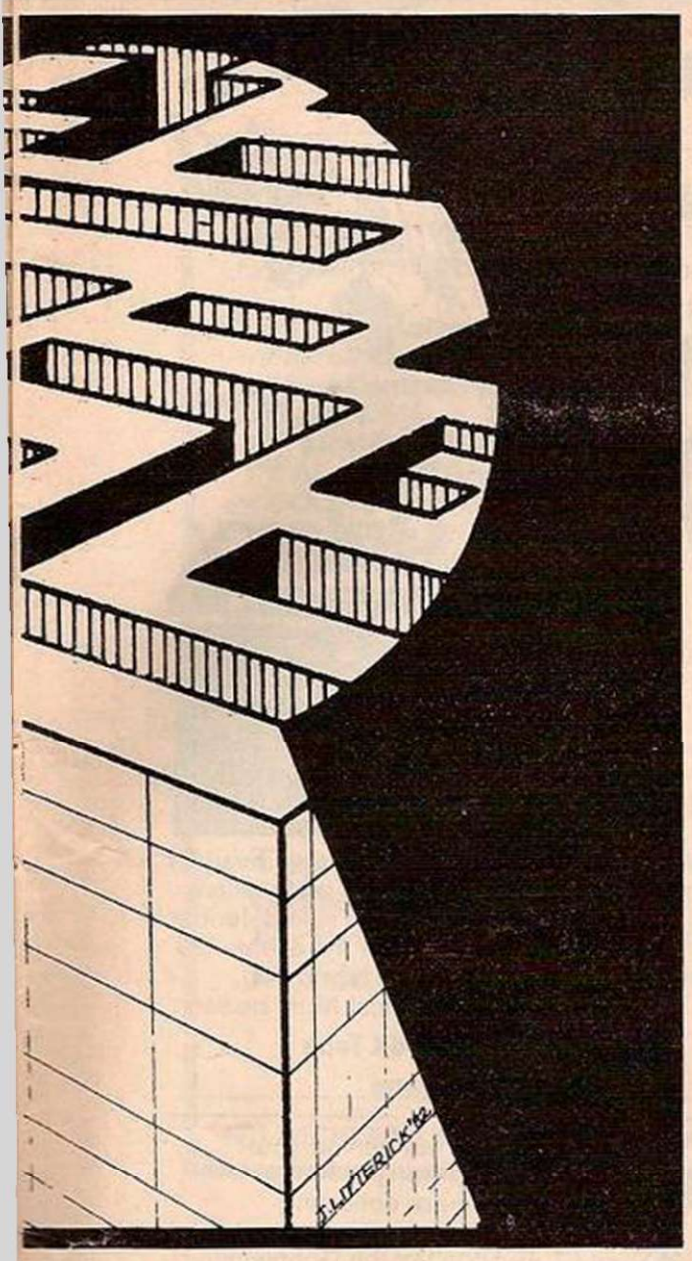
Lines 70-90 set up the maze. If you have chosen the difficult game, then the maze will be invisible.

Lines 100-130 set up the border of the maze. 32768 is the top left-hand corner of the maze.

Line 191: A is your starting position in the maze

```
READY.

 1 PRINT"[CLS]"
 2 B=50
 3 F=7
 4 PRINT"DO YOU WANT INSTRUCTIONS?(Y OR N)."
 5 INPUTA$:IFA$<>"Y"THEN9
 6 GOTO 3000
 9 PRINT"[CLS]":GOTO 2000
10 PRINT"DO YOU WANT TO PLAY THE EASY OR HARD GAME?(E OR H)"
11 GET P$
12 IF P$="H" THEN LL=96
13 IF P$="E" THEN LL=102
14 IF P$="" THEN 11
15 PRINT"[CLS]"
70 FOR A=1 TO B
80 POKE (INT(1000*RND(1)+32769)),LL
90 NEXT
95 REM SET UP BOUNDARIES
100 FOR A=32768 TO 32807:POKE A,102:NEXT
110 FOR A=33728 TO 33768:POKE A,102:NEXT
120 FOR A=32768 TO 33728 STEP40:POKE A,102:NEXT
130 FOR A=32807 TO 33768 STEP40:POKE A,102:NEXT
191 A=32830:D=33539:DD=33559
192 FOR L=32831 TO 32836:POKE L,32:NEXT
193 REM SET UP DOORS
195 FOR G=1 TO 4:POKE (INT(300 *RND(1)+33468)),4:NEXT
196 Q=TI
197 REM KEYBOARD SCAN
200 AA=PEEK(151)
201 POKE A,43:POKE D,94:POKE DD,94
205 IF (INT(F*RND(1)+1))=1 THEN GOSUB300
206 REM YOU MOVING
207 IF AA=255 THEN 200
210 IF AA=18 THEN C=40
220 IF AA=50 THEN C=-40
230 IFAA=42THENC=-1
240 IFAA=41THENC=1
250 POKEA,32
255 REM SEE IF YOU'VE HIT ANYTHING
260 IFPEEK(A+C)=LLTHENPOKE(A+C),102:GOTO200
261 IF PEEK(A+C)=102 THEN 200
265 IF PEEK(A+C)=94 THEN 500
267 IF PEEK(A+C)=4 THEN 600
270 A=A+C:POKEA,43
275 IF (INT(F*RND(1)+1))=1 THEN GOSUB 300
280 GOTO 200
290 REM MOVE ENEMY UP AND DOWN
300 IF (A-D)>-20 AND (A-D)<20 THEN 400
301 IF (A-DD)>-20 AND (A-DD)<20 THEN 400
310 IF D<A THEN E=40
311 IF DD<A THEN EE=40
320 IFD>ATHENE=-40
321 IF DD>A THEN EE=-40
330 POKED,32
331 POKE DD,32
335 REM TIMER
336 W=TI-Q:W=INT(W/60):IF W=20  THEN800
337 PRINT"[HOM]":PRINTW
338 IF PEEK(DD+EE)=43 THEN 500
340 D=D+E:POKE D,94
341 DD=DD+EE:POKE DD,94
350 RETURN
360 REM MOVING ENEMY SHIPS SIDEWAYS
400 IF D<A THEN E=1
401 IF DD<A THEN EE=1
410 IF D>A THEN E=-1
411 IF DD>A THEN EE=-1
420 POKE D,32
421 POKE DD,32
425 IF PEEK(D+E)=43 THEN 500
426 IF PEEK(DD+EE)=43 THEN 500
427 DD=DD+EE:POKE DD,94
430 RETURN
500 PRINT"[CLS]"
505 REM THEY GOT YOU
510 PRINT:PRINT:PRINT:PRINT"YOUR DEAD"
520 PRINT:PRINT:PRINT"DO YOU WANT ANOTHER GAME?(Y OR N)
530 INPUT K$:IFK$<>"Y"THEN END
540 RUN
600 PRINT"[CLS]"
610 LET H=INT(7*RND(1)+1)
620 IF H=1 THEN 700
630 IF H=4 THEN 750
635 M1=M1+1
640 PRINT:PRINT:PRINT"O.K LET'S GO UP TO LEVEL ";M1
645 FOR X=1 TO 2000:NEXT
650 B=B+50:F=F-1:IF F<2 THEN F=2
655 IF B>300 THEN B=300
660 PRINT"[CLS]"
665 GOTO 70
700 M=M+1:PRINT"[CLS]":PRINT:PRINT:PRINT"YOU'VE FOUND KEY";M
720 FOR X=1 TO 3000:NEXT
725 IF M=3 THEN RUN 999
730 PRINT"[CLS]":GOTO 70
750 PRINT"[CLS]":PRINT:PRINT:PRINT"O DEAR YOU'VE BEEN EATEN BY A MONSTER";
751 PRINT"   AND....."
760 GOTO 510
800 PRINT"[CLS]"
810 PRINT :PRINT:PRINT"YOU'VE RUN OUT OF TIME AND....."
830 GOTO 510
999 LETZZ=4
1000 PRINT"[CLS]"
1005 X2=33560
1100 REM SET UP SCREEN
1190 P=32775:O=P+4:R=P+8:S=P+16
1200 FORA=33648 TO 33687:POKEA,102:NEXT
1201 S1=32440:POKES1+10,102:POKES1+11,102
1202 POKES1+20,102:POKES1+21,102:POKES1+30,102:POKES1+31,102
1203 S2=33480:POKES2+10,102:POKES2+11,102:POKES2+20,102:POKES2+21,102
1204 POKES2+30,102:POKES2+31,102
1210 B=33610:C=112:D=113:E=110:F=32769:G=23645:H=B
1220 I=24:J=32:K=10:L=32:M=151
1230 POKEB,C:POKEB+1,D:POKEB+2,E
```



— middle of the top line. D and DD are the starting positions of the enemy, near the bottom of the maze.

Line 192 clears a space next to you so that you are not blocked in by the maze.
Line 195 sets up position of doors near the bottom of the maze.
Line 196: TI on the Pet is the function to call the clock.
Line 200: Peek (151) is the keyboard scan for the Pet and it allows for the return of a value for the key being pressed until that key is no longer pressed.
Line 201: 43 is the graphic code for + and 94 is the graphic code for π.
Line 205: this random function decides whether the enemy are going to move or not.
Lines 207-240: AA is the value obtained from Peek (151) and 255 is the value when no key is being pressed. 18 is the value for the key 2; 50 is the value for the key 8; 42 is the value for the key 4 and 41 is the value for the key 6.
Line 250: 32 is the graphic code for a blank space.
Line 260 checks to see if you have hit anything on the invisible maze and then makes it appear.
Lines 261-267 check to see if you have hit a square — graphic code 102 — a π — graphic code 94 — or a door — graphic code 4.
Line 270 moves you.
Line 275 is the same as line 205.
Lines 300-301 check to see if the enemy is on the same line as you.
Lines 310-331 moves enemy up or down depending on your position.
Line 336 converts the Pet clock into seconds for the timer of the game.
Lines 338-350 check to see if the enemy have caught up with you and move the enemy.
Lines 400-430 do the same as 300-350, but the enemy moves sideways.
Lines 500-540 are the endings.
Lines 600-630 decide whether there is to be a key, monster or staircase behind a door.
Lines 635-662 move you up to a more difficult level. More squares, B, and the enemy move faster, F.
Lines 700-735 are where you find a key.
Lines 750-760 are where you meet a monster.
Lines 800-830 are where you run out of time.
Line 999: ZZ is the number of lives.
Line 1005: X2 is three lines above the bottom line of the screen.
Line 1190: P,Q,R,S are the positions of the enemy.
Line 1200 draws the bottom line of the screen, graphic code 102 is for a square.
Lines 1201-1204 set the barriers.
Line 1210: B is the starting position for the laser base. C,D,E are the graphic codes for the laser base. F is the top-left hand corner of the screen. G is the furthest position, right, that the laser base can move.
Line 1220: 32 is the graphic code for a blank square. M is for the keyboard scan. 24 is the value from the keyboard scan for X. 10 is for 0 and 32 is for Z.
Line 1230 sets up the laser base.
Line 1240 is the keyboard scan.
Line 1250 goes to firing lines.
Lines 1260-1270 move the laser base.
Lines 1330-1440 move the enemy one at a time in the direction FF, i.e., sideways or down. RR is the flag to jump back to the correct line after line 1410 — it saves a subroutine. Z is the score.
Lines 1500-1545 deal with the laser bases' firing. 30000 is a convenient location in free RAM where the enemy are put after being hit. 42 is the graphic code for *.
Lines 1600-1650 are the enemy firing. The 16 cursor downs and the Print in lines 1620-1630 is to clear away the bullets when they have reached the bottom. These lines also contain the ability for the laser base to move. A For-Next loop is avoided here because of the difficulty of jumping out of it.
Lines 1800-1814 are the endings. ZZ is the variable of lives left. Sys (826) calls the machine-code subroutine which flashes the whole screen on and off in reverse video for a spectacular effect.
Lines 2000-2020 is the reverse-video routine.
Lines 3000-3260 are the instructions. ■

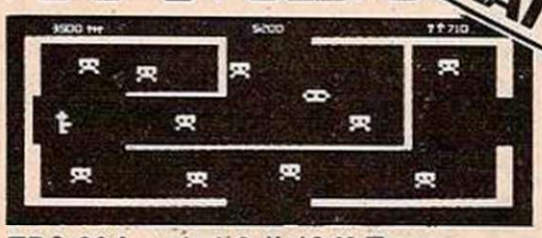
```
1235 REM KEYBOARD SCAN AND MOVE YOU
1240 N=PEEK(M):IFN<>KANDN<>IANDN<>JTHEN1320
1250 IFN=KTHEN1500
1260 IFN=IANDB<GTHENPOKEB,32:B=B+1:POKEB,C:POKEB+1,D:POKEB+2,E:GOTO1320
1270 IFN=JANDB>HTHENPOKEB+2,32:B=B-1:POKEB,C:POKEB+1,D:POKEB+2,E
1320 GG=GG+1:IFGG=8THENGG=1
1325 REM MOVE ENEMY
1330 ONGGGOTO1339,1349,1359,1369,1240,1240,1240,1240
1339 IFP<32000THEN1349
1340 T=P:RR=1:GOTO1400
1341 P=T:GOTO1240
1349 IFQ<32000THEN1359
1350 T=Q:RR=2:GOTO1400
1351 Q=T:GOTO1240
1359 IFR<32000THEN1369
1360 T=R:RR=3:GOTO1400
1361 R=T:GOTO1240
1369 IFS<32000THEN1339
1370 T=S:RR=4:GOTO1400
1371 S=T:GOTO1240
1380 REM LEFT? RIGHT? DOWN?
1400 LETEE=INT(10*RND(1)+1):FF=40:IFEE=2THENFF=1
1402 IFEE=1THENFF=-1
1404 T=T+FF:IFPEEK(T)=320RPEEK(T)=88THENPOKET-FF,32:POKET,88
1405 IFT>=33568THEN510
1407 PRINT"{HOM}":PRINTZ:IFPEEK(T)=102 THENEND
1410 IF(INT(2*RND(1)+1))=1THEN1600
1411 IFRR=1THEN1341
1412 IFRR=2THEN1351
1413 IFRR=3THEN1361
1414 IFRR=4THEN1371
1440 END
1500 X=B-39:FORY=XTOFSTEP-40:IFPEEK(Y)=LTHENPOKEY,93:NEXTY:GOTO1530
1501 REM YOU'RE FIRING
1505 IFPEEK(Y)=93THENYY=0%:GOTO1530
1506 IFPEEK(Y)=102 THEN 1530
1510 Z=Z+1:POKEY,42:POKEY,32:IFY=PTHENP=30000
1512 IFY=QTHENQ=30000
1513 IFY=RTHENR=30000
1514 IFY=STHENS=30000
1515 IFP<32000ANDQ<32000ANDR<32000ANDS<32000THEN1000
1530 AA=Y:FORY=XTOAASTEP-40:POKEY,L:NEXT
1540 POKEYY,32
1545 GOTO 1320
1550 REM IT'S FIRING
1600 YY=T+80
1601 YY=YY+40:IFPEEK(YY)<>LTHENPOKEYY,L:POKEYY-40,L:GOTO 1647
1610 POKEYY-40,32:POKEYY,93
1611 N=PEEK(M):IFN<>KANDN<>IANDN<>JTHEN1646
1612 IFN=IANDB<GTHENPOKEB,32:B=B+1:POKEB,C:POKEB+1,D:POKEB+2,E:GOTO1646
1613 IFN=JANDB>HTHENPOKEB+2,32:B=B-1:POKEB,C:POKEB+1,D:POKEB+2,E:GOTO1646
1614 IFN=KTHEN1615
1615 X=B-39:FORY=XTOFSTEP-40:IFPEEK(Y)=LTHENPOKEY,93:NEXTY:GOTO1623
1616 IFPEEK(Y)=93THEN1900
1617 IFPEEK(Y)=102THEN1623
1618 Z=Z+1:POKEY,42:POKEY,32:IFY=PTHENP=30000
1619 IFY=QTHENQ=30000
1620 IFY=RTHENR=30000
1621 IFY=STHENS=30000
1622 IFP<32000ANDQ<32000ANDR<32000ANDS<32000THEN1000
1623 AA=Y:FORY=XTOAASTEP-40:POKEY,L:NEXTY
1624 POKEYY,32
1646 IF YY< 33528THEN1601
1647 IFPEEK(YY+80)=113ORPEEK(YY+80)=110ORPEEK(YY+80)=112THEN1800
1648 PRINT"{16 CD}"
1649 PRINT"
1651 GOTO1411
1800 ZZ=ZZ-1
1805 REM ENDINGS
1806 ZZ$="LIVES"
1807 IFZZ=1THENZZ$="LIFE"
1808 PRINT"YOU'VE GOT";ZZ; ZZ$;" LEFT"
1809 FOR I3=1 TO 20 :FORI4=1TO20:NEXTI4:SYS(826):NEXTI3
1810 FORE3=1 TO 200 :NEXTE3
1812 IFZZ=0 THENPRINT"END OF GAME":GOTO520
1814 GOTO 1000
1900 AA=Y:FORY=X TO AA STEP-40:POKEY,L:NEXTY:GOTO 1411
1999 REM MACHINE CODE ROUTINE TO PUT WHOLE SCREEN INTO REVERSE VIDEO
2000 FORI1=826 TO 852:READJ1:POKEI1,J1:NEXT
2010 DATA 162,128,134,2,169,0,133,1,202,160,0,177,1,73,128
2020 DATA 145,1,200,208,247,230,2,224,124,208,238,96
2030 GOTO 10
2999 REM INSTRUCTIONS
3000 PRINT"{CLS}"
3010 PRINT"YOU HAVE BEEN HIRED BY THE ZUGS TO REPEL"
3020 PRINT"THE CUZANGS WHO ARE INVADING THE ZUG'S"
3030 PRINT:PRINT"PLANET.YOU HAVE ARRIVED A LITTLE TOO"
3040 PRINT:PRINT"LATE AND 2 OF THE CUZANGS HAVE ENTERED"
3050 PRINT:PRINT"THE ZUG'S MAIN CONTROL STATION.YOU"
3060 PRINT:PRINT"HAVE BEEN TOLD BY A FRIENDLY ZUG"
3070 PRINT:PRINT"THAT YOU HAVE TO PICK UP 3 KEYS TO"
3080 PRINT:PRINT"BE ABLE TO ENTER THE BATTLE ROOM"
3090 PRINT:PRINT"AND THESE KEYS CAN BE FOUND BEHIND THE"
3100 PRINT:PRINT"DOORS ON THE VARIOUS LEVELS OF THE BUILDING"
3110 PRINT"{REV} PRESS ANY KEY TO CONTINUE {OFF}"
3120 GET A$:IFA$=""THEN3120
3130 PRINT"{CLS}"
3140 PRINT"YOU ARE THE SHAPE '+' AND THE 2 INVADERS"
3150 PRINT"ARE 'π'."
3160 PRINT:PRINT"TO MOVE THROUGH THE BUILDING USE THE KEYS:"
3170 PRINT:PRINT"{REV}2=DOWN     8=UP     4=LEFT     6=RIGHT{OFF}"
3180 PRINT:PRINT"REMEMBER ALWAYS GO FOR A DOOR"
3190 PRINT:PRINT"THE INVADERS WILL EAT YOU IF THEY CATCH YOU";
3200 PRINT" AND THERE ARE SOME MONSTERS BEHIND  SOME DOORS!!"
3210 PRINT:PRINT"WHEN YOU GET INTO THE BATTLE ROOM"
3220 PRINT:PRINT"YOU HAVE 3 BASES AND TO MOVE:"
3230 PRINT:PRINT"{REV}Z=LEFT     X=RIGHT     0=FIRE{OFF}"
3235 PRINT"P.S YOU ONLY HAVE 20SECS TO GET OUT OF  EACH LEVEL IN THE BUILDING"
3240 PRINT"{REV}PRESS ANY KEY TO CONTINUE.{OFF}"
3250 GET A#:IFA$=""THEN3250
3260 GOTO 9
READY.
```

The Essential Software Company

47 Brunswick Centre, London WC1N 1AF

ROBOT ATTACK

THE GAME THAT TALKS

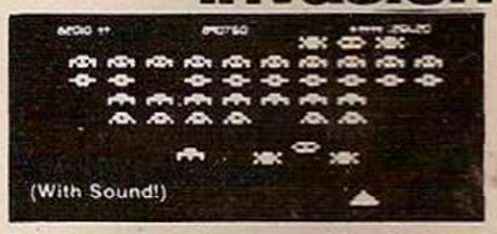


TRS 80 Levels I & II 16 K Tape
Video Genie 16 K Tape

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.

TRS80 VIDEO GENIE

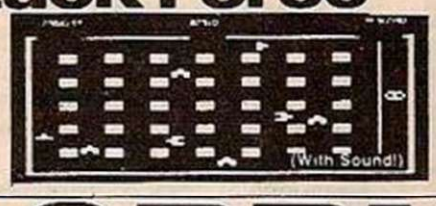
Galaxy Invasion



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



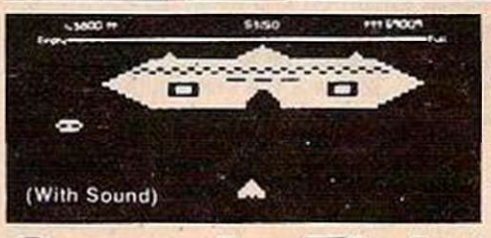
Dodge the alien Ramships and fire missiles to destroy them before they get you. The alien Flagship uses his deadly laser bolt to transform a Ramship into another Flagship or into your ship's double. Look out! Destroy your double and you could destroy yourself.

TRS 80 Level I & II 16K Tape
Video Genie EG3003 16K Tape

GOBBLE MAN

Watch out behind you! As you hurry through the maze collecting 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



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

Cosmic Fighter

SuperNOVA

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 laser, thrust, rotate or hit hyperspace to survive!

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 which allows full sentence input

Deathmaze and Labyrinth over 550 locations!

Asylum 1200

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 70p post & packing)

Signature .....

Name .....

Address .....

Postcode .....

My ACCESS No is .....

HILDERBAY LTD PROFESSIONAL SOFTWARE

If you don't believe that the Sinclair ZX81 can do real work, come and see us at the Computer Fair Exhibition, Earls Court (23rd-25th April) and the ZX Micro Fair, Central Hall, Westminster, London SW1 (30th April-1st May).

New product: a **RELIABLE** 16K RAM pack for the ZX81 £42

ZX81 + 16K Software:

* **Payroll** for up to 30 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
* **GOLD:** an adventure game. Try it if you have a week to spare With another game on same tape. £8
* **Memotech** 48K memory module for ZX81. £89
* 64K Memo Pak £79.

More details from us.
Crofton Professional Keyboards, Monitors, VDUs
Prices include VAT, Post & Packing
COD Orders £2 extra.

Tape hint: always rewind cassette, keeping their delicate recording surface protected inside the cassette housing.

COMPETITION
WIN A
48K MEMOTECH!

Open to all purchasers of 'GOLD' or Games Pack I.
A 48K Memotech will be sent to the player who sends us the highest score received by 31 July 1982! Monthly prizes of blank cassettes for your programs!
If you have already bought 'GOLD', send sae for a copy of the rules.

© HILDERBAY LTD 1981

HILDERBAY LTD (YCM), 8/10 Parkway, Regents Park, London NW1 7AA. Tel: 01-485 1059. Telex 22870

Have you bought a ZX81? Now here's a cassette recorder to match it!

The ECR81 Enhanced Certified Recorder from MONOLITH is a major advancement in cassette recorder technology which minimises the problems associated with standard audio recorders. This is a high quality proven cassette mechanism, enhanced to provide just the right signal levels to ensure reliable read and write data transfer between the magnetic tape and your ZX81.

£47.50
Including VAT.
complete

- Each ECR81 comes complete with its own individual certification tape, tested and serial numbered to prove your machine reliability.
- Signal enhancement circuit board with phase - locked - loop control and signal shaping for peak performance.
- A long life head is fitted, matched to TDK CrO2 high bias, super avilyn cassette tapes.
- Mains & DIN connector leads provided.
- Certification of tape head alignment - height and azimuth.
- Certified tape tension, torque and speed.
- Fast forward and rewind tape search controls.

The ECR81 is also suitable for Sinclair ZX80

To: MONOLITH ELECTRONICS CO. LTD., 5/7 CHURCH STREET, CREWKERNE, SOMERSET

Please supply me with:	Price	Total
_____(Qty.) Monolith ECR 81 Enhanced Certified Recorder(s) to be used with my ZX81	£47.50 (Each)	
I also enclose postage & packing per recorder	£2.50	
Prices include VAT	£	

Please print

Name: Mr/Mrs/Miss.

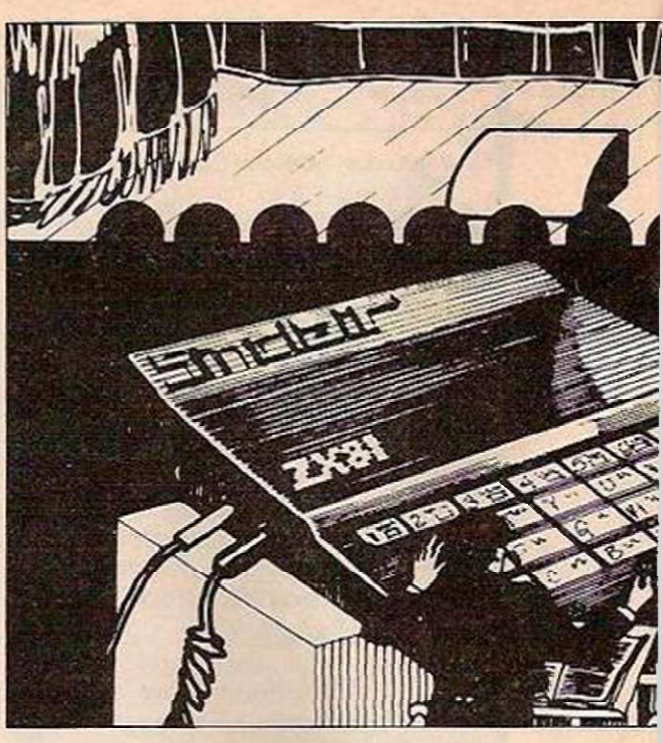
Address

● Please allow up to 28 days delivery. ● The ECR81 is backed by our 14 day money-back option. ● The ECR81 is not suitable for audio reproduction.

MONOLITH
electronic products
Telephone: Crewkerne 0460 74321

SOFTWARE

ZX-81 MUSIC



The ZX-81 may not be renowned for its dulcet tones, but passable music is well within its capabilities without hardware modifications. John Sylvester shows how.

THE ZX-81 HAS one major failing when it comes to creating music — it cannot use the video and create sound at the same time. Nevertheless, you can obtain pleasing results with the notes which cover an eight-octave range complete with semitones. The notes are at first estimated, and then fine-tuned with the aid of an electric organ. This is, of course, no guarantee that the final result is correct.

To hear the music generated, you can use a cassette recorder in record mode and, if available, use the monitor facility or feed the cassette output through a suitable amplifier.

The easiest wave-form to produce on a computer is that of a square wave, since this is a simple switching pattern. The number of times the wave-form is switched in one second denotes the frequency of the output. Figure 1 shows a square wave.

The time taken to complete one cycle is called the periodic time and in figure 1 is shown by t1. t2 and t3 are the times during which the wave-form is switched on and off. The periodic time is the reciprocal of the frequency in hertz or cycles per second.

If the frequency is 50Hz, the periodic time is 20ms., so t2 and t3 equal 10ms. each. If the periodic time is increased, the frequency decreases and conversely, if the periodic time is decreased, the frequency increases.

Now that we have seen how to produce a frequency by switching on and off, the question arises as to how to use the ZX-81 to achieve the same effect. J Chalmers, in Software File, December issue, suggested a simple circuit which would allow you to do this. However, the capability is built into the ZX-81 and there is no need for extra circuits.

Listening to a recording of a saved program you will notice that there is a definite variation in frequency. So, if we can discover how this is done, we can use the cassette port to produce our frequencies.

Without describing in detail the exact working of the cassette circuitry, it is sufficient to know that the output to the cassette is via port FF. This alone will not produce any response. After extensive experimenting I found that port FE was also involved, so that the instructions

OUT (FF),A

turned the cassette port on and

IN A,(FE)

turned it off. We now have the necessary data to produce the switching required.

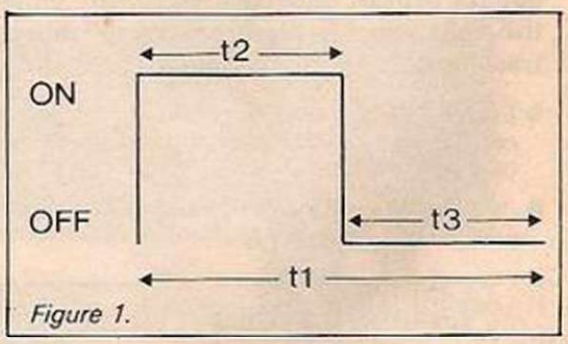


Figure 1.

Listing 1 contains machine code to control the cassette output. From the listing you will see that after output and input, there is a delay which produces the time required for t2 and t3. The length of note is determined by Time and this is decremented by the half-cycle count after one complete cycle. This means for a given value in Time, the duration of all notes is constant.

The machine code is placed in the Rem statement of Basic at line 1. Listing 2 gives a Basic program to be used in conjunction with the machine code. Lines 10 to 180 calculate

Listing 1. Machine code.

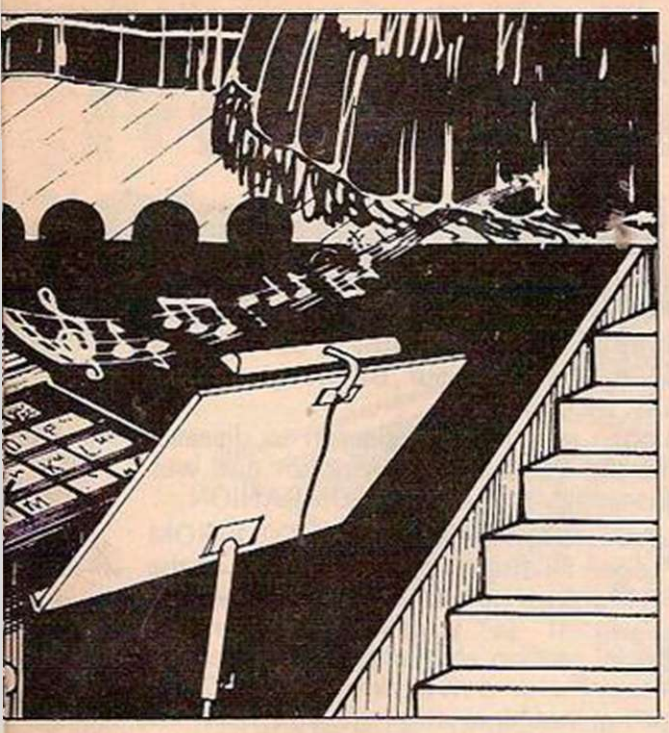
```
4082 FF 00        TIME   00FF            :DURATION COUNT
4084 00 00        FREQ   0000            :NOTE COUNT
4086 2A 82 40            LD    HL,(TIME)
4089 ED 5B 84 40         LD    DE,(FREQ)
408D 01 00 00            LD    BC,0
4090 E5           CYCLE  PUSH  HL        :SAVE DURATION ON STACK
4091 D3 FF               OUT   (FF),A     :TURN ON CASSETTE PORT
4093 CD A2 40            CALL  DELAY
4096 DB FE               IN    A,(FE)     :TURN OFF CASSETTE PORT
4098 CD A2 40            CALL  DELAY
409B E1                  POP   HL         :GET DURATION FROM STACK
409C B7                  OR    A          :CLEAR CARRY FLAG
409D ED 52               SBC   HL,DE      :DECREMENT DURATION BY
                                           ONE HALF CYCLE
409F 30 EF               JR    NC,CYCLE   :GO DO ANOTHER CYCLE
40A1 C9                  RET              :RETURN TO BASIC
40A2 2A 84 40     DELAY  LD    HL,(FREQ)  :GET DELAY FOR ONE HALF
                                           CYCLE
40A5 37           LOOP   SCF              :SET CARRY FLAG
40A6 ED 42               SBC   HL,BC      :DECREMENT DELAY BY ONE
40A8 30 FB               JR    NC,LOOP    :DELAY NOT DONE
40AA C9                  RET              :RETURN TO CALLER

NOTES:
1. VALUE IN FREQ MUST NEVER BE 0, OR PROGRAM WILL LOOP
   INDEFINITELY.
2. DURATION IS DETERMINED BY LOC 4083, LOC 4082 ALWAYS FF.
3. COUNT FOR A GIVEN FREQUENCY IS FOUND BY, 1/(F*17E-6).
```

Listing 2. The Basic program.

```
 1 REM ** THIS LINE WILL HOLD THE MACHINE CODE **
 9 REM ** INITIALISE VARIABLES **
10 DIM O$(8,7,2)
15 FAST
20 FOR J=1 TO 8
30 LET N=1
39 REM ** CALCULATES NOTE A **
40 LET F=INT((26*2**(J-1)+2**(J-1)*(2/3))+.5)
50 GOSUB 300
59 REM ** CALCULATES NOTE B **
60 LET F=INT((30*2**(J-1)+.5)
70 GOSUB 300
79 REM ** CALCULATES NOTE C **
80 LET F=INT((32*2**(J-1)+.5)
90 GOSUB 300
99 REM ** CALCULATES NOTE D **
100 LET F=INT((36*2**(J-1)+.5)
```

(listing continued on next page)



the frequency of a given note in a specific octave; lines 300 to 330 calculate the counts to give the half-cycle delays necessary to produce the required frequencies. To raise or lower the pitch of all octaves the value of 17E-6 in line 300 may be altered. All the counts calculated are stored as characters in the array 0$.

Lines 190 to 196 play an introductory tune after the initialisation of the array. The user can specify notes, octaves and duration of the notes in lines 200 to 260. Notes are entered using A to G; semitones are indicated by inverse A,B,D,E and G; a pause by entering a space at the required point is performed in lines 1200 to 1220.

Variable	Use
0$	Array for holding the counts for the relevant frequencies
J	Octave pointer for array 0$
N	Note pointer for array 0$
X$	Octave string
N$	Note string
D$	Duration string
F	Calculation of frequency and MSD of count for frequency
X	String pointer used with X$, N$ and D$
F1	LSD of count for frequency
T	Pause count
SF	Semitone flag for direct-keyboard operation

Glossary.

Octaves are indicated by 1 to 8, and the duration by 0 to F. Lines 1000 to 1110 constitute the subroutine which scans the input data. They also retrieve the correct counts from the array and Poke them into the locations in the machine code. The machine-code program is then entered.

Lines 1500 to 1620 calculate the values of the semitones and Poke them into the correct locations. Lines 2000 to 2065 allow the user to play direct from the keyboard. The octave is selected by pressing the keys 1 to 8, and the notes by keys A to G. If a semitone is required, the S key is pressed before the note. The duration in this mode is set to 1 — line 2050. Press K to return to the normal mode.

You can use the machine-code routine to produce sound effects by Poking the locations with the counts to achieve the correct frequency and duration. ■

(listing continued from previous page)

```
110 GOSUB 300
119 REM ** CALCULATES NOTE E **
120 LET F=INT((40*2**(J-1)+.5)
130 GOSUB 300
139 REM ** CALCULATES NOTE F **
140 LET F=INT((42*2**(J-1)+2**(J-1)*(2/3))+.5)
150 GOSUB 300
159 REM ** CALCULATES NOTE G **
160 LET F=INT((48*2**(J-1)+.5)
170 GOSUB 300
180 NEXT J
189 REM ** PLAY INTRODUCTORY TUNE **
190 LET X$="333333343 3333333"
191 LET N$="CEGGGGGCG EFGGFDC"
195 LET D$="113333711111144448"
196 GOTO 270
199 REM ** INPUT DATA - K TRANSFERS CONTROL DIRECT TO KEYS **
200 PRINT "NOTES A-G"
204 INPUT N$
205 IF N$(1)="K" THEN GOTO 2000
210 PRINT "OCTAVES 1-8"
230 INPUT X$
250 PRINT "DURATION 0-F"
260 INPUT D$
270 GOSUB 1000
275 CLS
280 GOTO 200
299 REM ** CONVERT NOTES TO FREQUENCY COUNT **
300 LET F=INT((1/(F*17E-6))+.5)
305 LET 0$(J,N,2)=CHR$(F-(INT(F/256)*256))
310 LET 0$(J,N,1)=CHR$(INT(F/256))
320 LET N=N+1
330 RETURN
999 REM ** START PLAYING TUNE **
1000 FOR X=1 TO LEN N$
1010 LET N=CODE N$(X)-37
1020 LET J=CODE X$(X)-28
1030 LET D=(CODE D$(X)-28)*16
1039 REM ** TEST FOR SEMITONE **
1040 IF N>128 THEN GOTO 1500
1044 REM ** TEST FOR PAUSE **
1045 IF N<0 THEN GOTO 1200
1050 POKE 16516,CODE 0$(J,N,2)
1060 POKE 16517,CODE 0$(J,N,1)
1070 POKE 16515,D
1080 LET C=USR 16518
1090 NEXT X
1110 RETURN
1199 REM ** PAUSE ROUTINE **
1200 FOR T=1 TO D*8
1210 NEXT T
1220 GOTO 1090
1499 REM ** SEMITONE GENERATOR **
1500 LET N=N-128
1505 IF N=1 OR N=2 OR N=4 OR N=5 OR N=7 THEN GOTO 1510
1506 STOP
1510 IF N=1 THEN GOTO 1600
1520 LET F=256*CODE 0$(J,N-1,1)+CODE 0$(J,N-1,2)
1530 LET F1=256*CODE 0$(J,N,1)+CODE 0$(J,N,2)
1540 LET F=INT((F1+F)/2+.5)
1550 LET F1=F-(INT(F/256)*256)
1560 LET F=INT(F/256)
1570 POKE 16516,F1
1580 POKE 16517,F
1590 GOTO 1070
1600 LET F=256*CODE 0$(J,N,1)+CODE 0$(J,N,2)
1610 LET F1=256*CODE 0$(J-1,7,1)+CODE 0$(J-1,7,2)
1620 GOTO 1540
2000 LET SF=0
2002 IF INKEY$="" THEN GOTO 2002
2010 LET N$=INKEY$
2015 IF N$="K" THEN GOTO 200
2020 IF N$="S" THEN LET SF=1
2030 IF N$>"0" AND N$<"9" THEN LET X$=N$
2040 IF N$<"A" OR N$>"G" THEN GOTO 2002
2045 IF SF=1 THEN LET N$=CHR$(CODE N$+128)
2050 LET D$="1"
2055 LET SF=0
2060 GOSUB 1000
2065 GOTO 2002
```

FROM THE PUBLISHERS OF THE BEST SELLING BOOKS FOR THE SINCLAIR COMES:

Not Only But Also..

PROGRAMS FOR THE SINCLAIR ZX81...IK

Probably the LARGEST range of ZX 81 Software in the WORLD

Not Only...does this book contain over 30 fully debugged and exciting programs, every one of which will fit into the basic IK memory of your **Sinclair ZX81** —including programs such as **STAR WARS, LUNAR LANDER, BLACKJACK, MINI ADVENTURE, DRAUGHTS, BREAKOUT.**

But Also

- Detailed explanation of how these programs were written.
- Lots of hints on how you can write exciting programs for your **ZX81.**
- Numerous space saving techniques — obviously invaluable to the **ZX81** owner.
- **PEEKS and POKES** and all the other 'complicated' functions are clearly explained.
- **MUCH, MUCH MORE...**

Understanding Your ZX81 ROM

Plus special section: How to use machine code routines in your BASIC programs. by DR. I. LOGAN.

Dr Logan was the first person to dissassemble the Sinclair ZX80 Monitor and was the co-author of the ZX80 COMPANION.

In UNDERSTANDING YOUR ZX81 ROM Dr. Logan illustrates all the facilities of the ZX81 Monitor, how it works and how you can use it in your own programs. A special section shows you how you can squeeze more power into your ZX81, by using machine language and machine language subroutines.

An essential book for those who really want to understand the full working of the SINCLAIR ZX81.

Published by MELBOURNE HOUSE PUBLISHERS LTD.
Send Stamped, self-addressed envelope for FREE catalogue.

THE ESSENTIAL SOFTWARE COMPANY (Visconti Ltd)
47 Brunswick Centre, London W1CN 1AF (01-837 3154)

☐ Please rush me NOT ONLY 30 PROGRAMS FOR THE SINCLAIR ZX81 1K: at £6.95 each

☐ Please also rush UNDERSTANDING YOUR ZX81 ROM by Dr. I. Logan at £8.95

I enclose a cheque/postal order for £.....+50p post and pack.

Name .....

Address .....

THE ZX81 POCKET BOOK

A STACK OF GAMES AT YOUR FINGERTIPS

BOOK

136 PAGE BOOK

Programs
- *ZX81 ADVENTURE.
  - City of Alzan
  - Create your own
- BALL AND BUCKET
- PAINT-A-PIC
- DIGITAL CLOCK
- *SKI RUN
- Plus 20 more Programs

Articles
- Using machine code
- Efficient Programming
- String Manipulation
- Plus more

ONLY £5.95 inc P.P

*REQUIRE 16K RAM

Also available

ZX81 *Adventure TAPE

GREEDY GULCH
MAGIC MOUNTAIN
PHARAOHS TOMB

ALL 3 for £5.00 inc vat & P.P

***ZX81 Pocket book Cassette**

All programs & subroutines from the book on 1 tape

£5.00 inc vat & P&P

BARCLAYCARD VISA

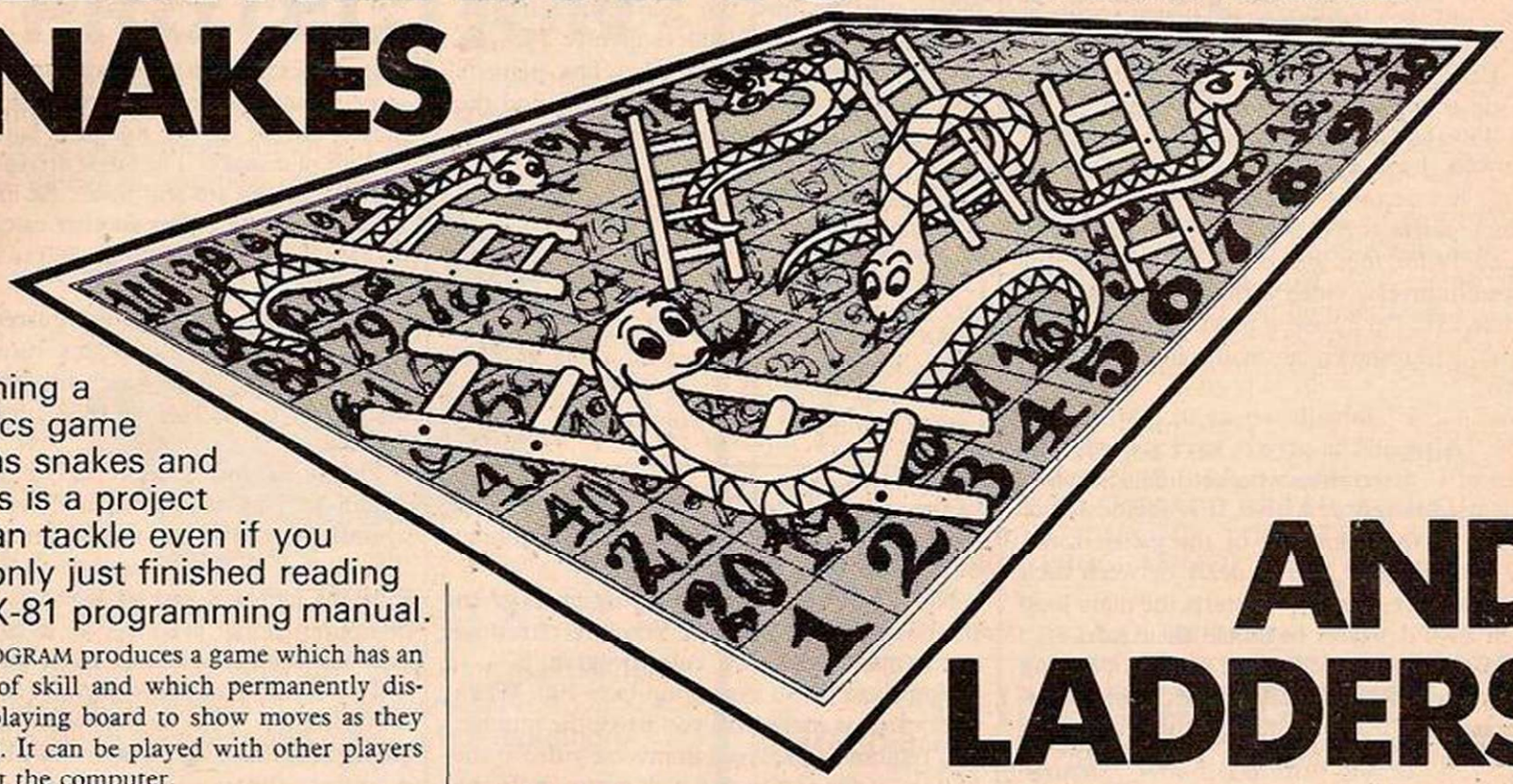
Access

PHIPPS ASSOCIATES

(Mail Order Dept B)
99 East St, Epsom Surrey, Tel 03727 21215
quoting your credit card No, 24hr phone service
Air Mail Europe plus 70 p Elsewhere plus £1.70

MESMERISING SNAKES AND LADDERS

BY BRIAN HORSFIELD



Designing a graphics game such as snakes and ladders is a project you can tackle even if you have only just finished reading the ZX-81 programming manual.

THIS PROGRAM produces a game which has an element of skill and which permanently displays a playing board to show moves as they are made. It can be played with other players or against the computer.

The program is built up in stages starting with important subroutines which are then lined together by a main program loop.

The game is played on a 10-by-10 grid with 100 bases. The bases are numbered and the numbers move up the grid as shown in figure 1. This can be achieved on the screen using Print At giving each base its own pair of line and column numbers. These numbers are stored in two arrays. Type program 1 into your ZX-81 — it will produce a simple grid.

Add line 1145 Slow if you want to watch the grid display forming. Line 1060 decreases the screen line number by two when a group of 10 bases has been allotted its line numbers. Line 1080 decides whether the base column numbers will number from 2 to 29 at line 1090 or from 29 to 2 at line 1110. Note that the bottom three screen lines are free for messages or instructions.

Add program 2 to the program. It will number the bases. Lines 1170 and 1180 print the first nine digits in inverse video. Line 1190 deals with the numbers 10 to 99 by printing the tens and units separately. Number 100 is catered for separately.

Next the snakes and ladders bases need to be identified. You can choose any locations for these bases and identify them in your own way. I have located seven of each with the ladders, LL, located towards the lower part of the grid display and the snakes, SS, towards the upper part.

```
1200 IF F=24 OR F=30 OR F=54 OR F=64 OR
     F=87 OR F=93 OR F=98 THEN PRINT
     AT L(F),C(F);"SS"
1210 IF F=7 OR F=15 OR F=19 OR F=35 OR
     F=50 OR F=60 OR F=71 THEN PRINT
     AT L(F),C(F);"LL"
```

Moves in the board game are normally made on the roll of a die. The ZX-81 can produce random numbers. However, to introduce a measure of skill into the game, program 3 can be used to decide each move.

This subroutine, starting at line 600, sets a pixel moving quickly across the bottom of the screen. Pressing key P takes the program out of the subroutine with the value of X fixed at the value it had when the P key was pressed. The value of X, which may be 4, 14, 24, 34, 44 or 54, is converted at line 250 into a number from 1 to 6.

The value of Step in line 620 may be altered to 5 without altering the ratio of chances of catching one of the digits 1 to 6. Line 710 takes the program back into the subroutine loop if key P has not been pressed.

The Print statements on lines 310 and 600 must contain the same number of symbols, including spaces, so that they will completely erase one another. Now type in the main stem of the listing — program 4 — including the

(continued on next page)

Program 1.

```
1000 DIM L(100)
1010 DIM C(100)
1020 FAST
1030 LET B=0
1040 LET E=0
1050 FOR F=1 TO 100
1060 IF F=11 OR F=21 OR F=31 OR F=41
     OR F=51 OR F=61 OR F=71 OR F=81 OR
     F=91 THEN LET E=E+2
1070 LET L(F)=18-E
1080 IF F>10 AND F<21 OR F>30 AND
     F<41 OR F>50 AND F<61 OR F>70 AND
     AND F<81 OR F>90 THEN GOTO 1110
1090 LET C(F)=2+B
1100 GOTO 1120
1110 LET C(F)=29-B
1120 LET B=B+3
1130 IF B=30 THEN LET B=0
1140 NEXT F
1160 FOR F=1 TO 100
1180 PRINT AT L(F),C(F);"□□"
1220 NEXT F
RUN NEWLINE
```

(listing continued on next page)

(continued from previous page)

main loop which starts at line 200.

Array P stores each player's position on the grid. All the positions are initially set at zero. The value of X is added to the player's score at line 410 and then variable Y is given the value of the player's position. This is to avoid having to type in P(J) too many times — see line 450 and later in the subroutine starting at line 800. Line 450 restores a base after the player has occupied it and then moves on.

Each player is represented by a letter, A, B, C and D for four players. The letter is displayed in inverse video with the player's name by line 210. On a base, a player is represented by his letter shown normally and in inverse video.

Variable U, initially set at 0, is given the value 1 after all the players have started. The value of U determines whether line 450 needs to be used to restore a base. It is obviously not needed at the beginning of the game. Lines 480 and 490 give a short delay between each player's move. Line 510 restarts the main loop when all the players have had their turn.

The snakes and ladders are not yet operating and worse still the snake and ladder bases disappear when a man lands on them and then passes on. This situation is improved by adding program 5.

A check is made to see whether a player has landed on a ladder, line 800, or a snake, line 810. Then the program returns to the main program if neither situation has arisen or moves further into the subroutine. In this program, snakes and ladders involve a loss or gain of 16 bases respectively. The player's position is changed, line 840 or 880, and the appropriate message is displayed at the bottom

Figure 1.

COLUMN →	2	5	8	11	14	17	20	23	26	29
LINE ↓ 0	100	99	98	97	96	95	94	93	92	91
2	81	82	83	84	85	86	87	88	89	90
4	80	79	78	77	76	75	74	73	72	71
6	61	62	63	64	65	66	67	68	69	70
8	60	59	58	57	56	55	54	53	52	51
10	41	42	43	44	45	46	47	48	49	50
12	40	39	38	37	36	35	34	33	32	31
14	21	22	23	24	25	26	27	28	29	30
16	20	19	18	17	16	15	14	13	12	11
18	1	2	3	4	5	6	7	8	9	10

of the screen. Line 220 removes the messages from the bottom of the screen at the beginning of the next player's turn.

Note that P(J), the player's position, is given the possibly new value of Y before returning to the main loop. Now enter program 6.

You must finish exactly on base 100. When your catch is more than you need, the number you require is displayed in inverse video at the bottom of the screen and play passes on to the next player. Lines 370 and 380 enable you to go right into another game should you require it.

```
280 FOR I = 1 TO P
290 IF P(J)+X = P(I) THEN GOTO 230
300 NEXT I
```

These lines prevent two players occupying the same ordinary base. However, more than one player can be at the top of a ladder or the bottom of a snake. The latest arrival shows up but any others are still there. At line 290 the Goto allows the player another catch. It could be used to move play to line 480 so that a turn is lost.

Program 7 causes a player's current position to be highlighted during his turn before a catch is made. The base displayed flashes alternately from A[A] to [A]A until key P is pressed.

Finally, if you do not have a friend with whom to play the game, and want to play against the computer, then enter program 8. The string %ZX81% in lines 160 and 230 must be identical and six symbols long. The computer cannot press key P, so at line 270 a random number is chosen to be its catch.

The game is now complete except for any modifications you might want to make — perhaps to make each player start by catching a six. ■

(listing continued from previous page)

Program 2.

```
      1150 LET C(100)=1
EDIT  1160 FOR F=1 TO 99
      1170 IF F>9 THEN GOTO 1190
EDIT  1180 PRINT AT L(F),C(F);CHR$128;
           CHR$(F+156)
      1190 PRINT AT L(F),C(F);CHR$(INT
           (F/10)+156);CHR$(F-10*INT(F
           /10)+156)
      1230 PRINT AT L(100),C(100);"100"
```

Program 3.

```
       190 GOSUB 600
       240 GOSUB 1000
       250 LET X=INT((X+10)/10)
       310 PRINT AT 20,16;"YOU CAUGHT A """;X;""""
       360 PAUSE 9999
       600 PRINT AT 20,16,"%%%PRESS ""P""%%%%"
       620 FOR X=4 TO 54 STEP 10
       670 PLOT X,0
       680 IF INKEY$="P" THEN GOTO 720
       690 UNPLOT X,0
       700 NEXT X
       710 GOTO 620
       720 RETURN
      1240 SLOW
      1250 RETURN
```

Program 4.

```
        20 LET U=0
        30 PRINT AT 5,5;"SNAKES AND LADDERS"
        40 PRINT AT 15,0;"HOW MANY PLAYERS? 2-4"
        50 INPUT P
        60 IF P<2 OR P>4 THEN GOTO 50
        70 DIM P$(P)
        80 DIM P(P)
        90 FOR F=1 TO P
       100 PRINT "NAME OF PLAYER ";F;"?"
       110 INPUT P$(F)
       120 LET P(F)=0
       130 NEXT F
       140 CLS
       200 FOR J=1 TO P
       210 PRINT AT 20,0;CHR$(J+165);CHR$0;P$(J);"S TURN"
       320 IF P(J)+X<100 THEN GOTO 410
       410 LET P(J)=P(J)+X
       420 LET Y=P(J)
       430 PRINT AT L(Y),C(Y);CHR$(J+165);CHR$(J+37)
       440 IF U=0 THEN GOTO 460
       450 PRINT AT L(Y-X),C(Y-X);CHR$(INT((Y-X/10)+156);
           CHR$(Y-X-10*INT((Y-X)/10)+156)
       460 IF J=P THEN LET U=1
       480 FOR F=1 TO 60
       490 NEXT F
       500 NEXT J
       510 GOTO 200
```

Program 5.

```
        10 LET L$=" 32 SPACES "
       220 PRINT AT 21,0;L$
       470 GOSUB 800
       800 IF Y=7 OR Y=15 OR Y=19 OR Y=35 OR Y=50 OR Y=60
           OR Y=71 THEN GOTO 830
       810 IF Y=24 OR Y=30 OR Y=54 OR Y=64 OR Y=87 OR
           Y=93 OR Y=98 THEN GOTO 870
       820 GOTO 900
       830 LET Y=Y+16
       840 PRINT AT L(Y),C(Y);CHR$(J+165);CHR$(J+37);AT 21,0;
           """LADDER""""LADDER""""LADDER""""LADDER"""
       850 PRINT AT L(Y-16),C(Y-16);"LL"
       860 GOTO 900
       870 LET Y=Y-16
       880 PRINT AT L(Y),C(Y);CHR$(J+165);CHR$(J+37);AT 21,0;
           "SSSSSSSSSSSSSSSSSSSSSSSSSSSNAKE"
       890 PRINT AT L(Y+16),C(Y+16);"SS"
       900 LET P(J)=Y
       910 RETURN
```

Program 6.

```
       330 IF P(J)+X>100 THEN GOTO 390
       340 PRINT AT 0,1;"HOME";AT 20,0;P$(J);" WINS.
           WELL DONE ";P$(J)
       350 PRINT " CONGRATULATIONSCONGRATULATIONS"
       370 CLS
       380 GOTO 10
       390 PRINT AT 21,8;"YOU NEED A ";CHR$(100-P(J)
           +156)
       400 GOTO 480
```

Program 7.

```
       610 LET Z=1
       630 IF P(J)=0 THEN GOTO 670
       640 IF Z/2<>INT(Z/2) THEN PRINT
           AT L(P(J)),C(P(J));CHR$(J+
           37);CHR$(J+165)
       650 IF Z/2=INT(Z/2) THEN PRINT
           AT L(P(J)),C(P(J));CHR$(J+
           165);CHR$(J+37)
       660 LET Z=Z+1
```

Program 8.

```
EDIT   40 PRINT AT 15,0;"HOW MANY PLAYERS? 1 TO 4"
EDIT   60 IF P<1 OR P>4 THEN GOTO 50
EDIT   70 DIM P$(P+1,6)
EDIT   80 DIM P(P+1)
       150 IF P>1 THEN GOTO 190
       160 LET P$(2)="%ZX81%"
       170 LET P=2
       180 LET P(2)=0
       230 IF P$(J)="%ZX81%" THEN GOTO 270
       260 GOTO 280
       270 LET X=INT(RND*6+1)
```

YOU NEED PROTECTION

Which is just what our mains filter unit does, it protects your computer from high speed transients and voltage spikes coming in on the mains supply, the cause of irritating glitches and hiccups.

5 AMP DUAL OUTLET £24.95 inc VAT & post
10 AMP DUAL OUTLET £28.95 inc VAT & post

This double outlet filter unit combines mains interference suppression to B.S.613 on 250V A.C. 50 to 60 Hz with transient and mains spike reduction.

Please send your orders with cheques/P.O. to

COMPUTER CABLE SERVICES
FREEPOST
59 Vicarage Walk, Watton,
THETFORD, Norfolk IP25 6BR.

Please allow 28 days for delivery.

CREATE SOUND EFFECTS ON YOUR ZX80/81 WITH THE USER PORT

FULL RANGE AUDIO OUTPUT DIRECT TO LOUDSPEAKER. Will simultaneously drive RELAY and SPEAKER, and allow 6 other control outputs. AND simultaneous use of 6 INPUTS, allowing JOYSTICKS, LIGHT DETECTORS, SWITCHES . . . All controlled from BASIC.
The FIRST and still the best User Port for the ZX80/81; And the only one allowing DIRECT LOUDSPEAKER and RELAY DRIVE. THOUSANDS already sold.
UNIT plugs into rear of the ZX and can be used with PRINTER AND RAMPACK on ZX81 — no extra motherboard required. All plugs and connectors included in price.
USER PORT KIT £11.50 + 40p p&p
USER PORT BUILT AND TESTED £14.95 + 70p p&p
REPRINT OF PCW ARTICLES giving masses of applications, including KEYBOARD ORGAN, SOUND EFFECTS, COMBINATION LOCK, LOGIC TESTER, RELAY CONTROL, PROGRAMMED TIMER etc. etc. £1.00 + large SAE.

SEND SAE FOR DETAILS ON ZX80/81 SOFTWARE

TECHNOMATIC LTD.

Mail Orders to: 17 Burnley Road, London NW10 1ED
Shops: 15 Burnley Road, London NW10
(Tel: 01-452 1500/450 6597)
305 Edgware Road, London W2

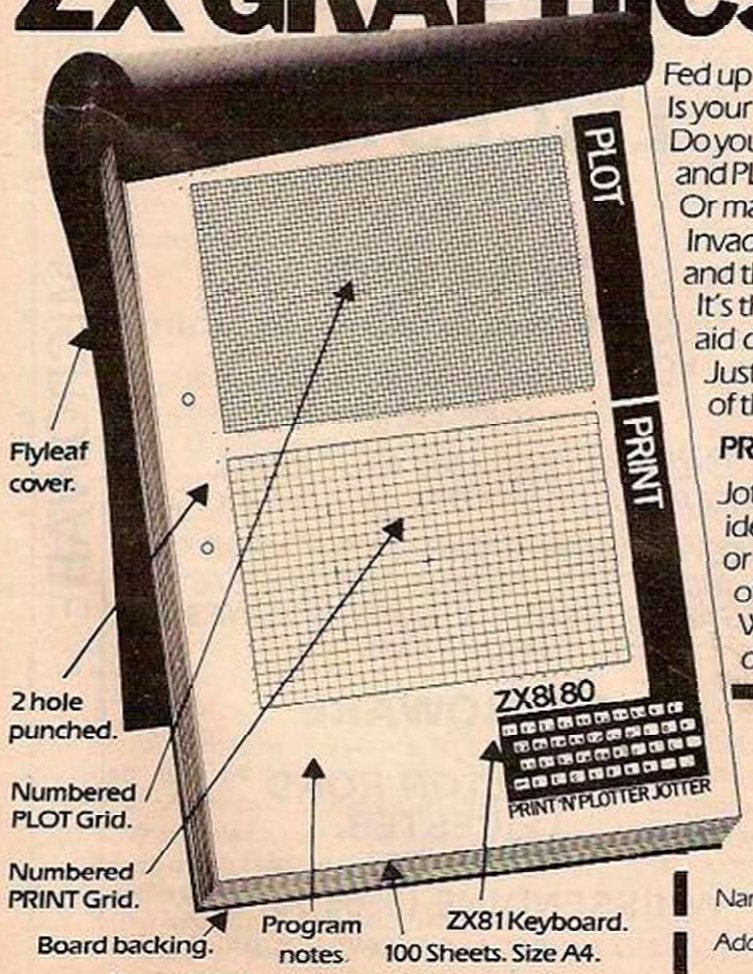
PRICES ARE EXC. OF VAT ADD 15% VAT TO ORDER VALUE

ORDERS FROM SCHOOLS COLLEGES etc WELCOME

SEND SAE FOR COMPONENT PRICES

BARCLAY & ACCESS ACCEPTED

HOW TO GET SERIOUS ABOUT ZX GRAPHICS FOR ONLY £3·50



Also available 'over the counter' at
Denny's Booksellers, 2 Carthusian St., London EC1.
Buffer Micro Shop 374a Streatham High Rd. London SW16.

Fed up with listings that ignore the graphic approach?
Is your PRINTING and PLOTTING still guesswork?
Do you want to write data programs with graphic PRINT AT and PLOT and professional looking 'windows' and 'scrolls'?
Or maybe you're still trying to find the successor to Space Invaders! All you need is ingenuity...
and the **PRINT'N'PLOTTER JOTTER.**
It's the professionally-produced ZX Graphics-aid designed by enthusiasts....for enthusiasts.
Just take a look at the specification - then think of the possibilities for **real** graphic graphics!

PRINT'N'PLOTTER FILM TOO — FOR ONLY £2.25!

Jotter 'FILM' is a matt Polyester film version of the "JOTTER" Grids identical in size so you can co-ordinate **precisely** PRINT and PLOT or you can copy photographs, drawings, maps, charts! The surface of the film is ideal for drawing (with pencil) and erasure.
With both JOTTER and FILM the graphics possibilities are enormous — despite low resolution. Isn't it time you got serious about ZX Graphics?

Post to Butler, Currie & Hook, 19 Borough High Street, London SE1 9SE.

Please send me _____ "Jotters" @ £3.50 (inc VAT, P&P)
Please send me _____ "Films" @ £2.25 (inc VAT, P&P)
Please send me your illustrated leaflet — I enclose a stamp.

Please bill my Access/Barclaycard No: _____

Name _____

Address _____

Post Code _____

All goods are despatched within 48 hours of receipt. If you require 1st Class return post please add 50p to "Jotter" price.

ZX81/ 80
HARDWARE AND SOFTWARE
ADD REAL POWER TO YOUR ZX81/ 80

New quality peripherals for professional and personal use.

I/O PORT
16 digital outputs, 8 digital inputs, 6 peripheral selects, programmable input output port plugs directly into your ZX81/80.
FEATURING: stackable connector allowing further peripherals to be added, e.g. 16K RAM and printer. Experimenter area giving space for relays, ICs, etc. On board test LED and buffer. Simple expansion to ADCs, DACs, etc., using pripheral selects. Operate using PEEK and POKE statements.
Assembled and tested ONLY £16.50 including manual.
In kit form ONLY £13.95.

ANALOGUE PORT
An 8 channel multiplexed analogue to digital converter, 8 line logic level output and 6 line peripheral select port. Measure up to 8 input voltages to a resolution of 0.39% (8 bit), enabling the monitoring of almost any transducer voltage.
FEATURING: 100usec conversion time and adjustable input sensitivity. On board voltage input amplifier with variable gain, stackable connector, experimenter area, test LED and buffer.
Assembled and tested ONLY £29.95 including manual.

ZX81 EXPERIMENTER KIT
23+23 edge connector. Price £4.00.
Stacking strip. Price £1.50.
Edge connector + stackable strip + veroboard assembled and with suggested circuit diagrams ONLY £6.50.

REAL TIME CLOCK
500nsec access time, auto leap adjustment, month, day, hour, second and tenth second. Rechargeable battery option so that time is kept even when ZX81 is switched off. Stackable connector. ONLY £28 (not inc. batteries) or £32 (inc. batteries).

FFT SOFTWARE
Together with our analogue port this makes an ideal educational tool for those wishing to demonstrate the use of Fast Fourier Transform analysis and its associated use in modern digital signal processing. Price ONLY £15.20.
P&P FREE on orders over £30 otherwise *add £1.* Delivery normally *return of post* on I/O, analogue port and kits; up to 28 days on other products. Money back guarantee if not satisfied. Cheques and PO payable to UNIVERSITY COMPUTERS. Bulk orders, official orders, etc. accepted.

UNIVERSITY COMPUTERS
5 ST. BARNABAS ROAD,
CAMBRIDGE CB1 2BU

P.S. WE OFFER A FREE CONSULTANCY SERVICE TO OUR CUSTOMERS

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.

MICROWARE

NEW SHOP OPEN
(13th MARCH 1982)
IN

LEICESTER
FOR

ZX81

ACCESSORIES

SOFTWARE

CASSETTES AND PROGRAMS CAREFULLY VETTED AND CHECKED

KEYBOARDS, RAMPACKS I/O PORTS MONITORS, TAPE INTERFACE ETC. GAMES, SERIOUS, HOME/BUSINESS PROGRAMS

MICROWARE

131 MELTON ROAD
LEICESTER
TEMP. TEL.
WHISSENDINE (0664 79) 722

CLOSED THURSDAYS EXCEPT HOLIDAYS

MICROWARE

MICROWARE

MICROWARE

Points implicated in polar co-ordinate plot

Polar plotting can be instructive and entertaining. Curiously, it receives little attention in education. Bev Mason sets out to correct this anomaly with his Basic program.

GRAPHICAL METHODS which use polar co-ordinates tend to be neglected in schools. This may be due in some degree to the fact that polar co-ordinate graph paper appears to be less readily available than the more familiar Cartesian co-ordinate paper.

Now that computers are becoming relatively common in the classroom, the video screen can be used to show practical examples of polar graphs where previously such plots were roughly indicated and left to the imagination. The curves can now be demonstrated in all their beauty.

Apart from any application in the teaching of mathematics, a program for plotting polars can provide a good deal of amusement. It is mentally stimulating to try and arrive at an equation which will yield a given pattern, and the results can be both attractive and surprising.

Initially, to write a program to plot graphs on the computer screen using the more usual Cartesian co-ordinates can be frustrating. The graph has to be contained within the confines of the screen and this entails calculating scale factors for both x and y, often when the maximum values of one or both variables are not known. Also the positions of the axes have to be determined allowing for possible negative values.

Economical program

These problems are comparatively easy to solve with polar co-ordinates. For most functions all that is necessary is to locate the pole in the centre of the screen, and the single scale factor is readily determined.

The basic program is written in Microsoft Basic originally for a Video Genie. The full list occupies about 0.7K of memory, but a shorter version, using about 0.3K can be employed. This again could be tidied up considerably.

```
 40 CLS
 50 INPUT "ENTER SCALE FACTOR"; C: GOTO80
 60 R=SIN(4*A)
 70 RETURN
 80 INPUT "ENTER INCREMENT OF A"; DA
100 IF DA>0 GOTO 310
110 PRINT "CALCULATING"
120 DA=1: S=0.524: T=-0.005
130 FOR M=0 TO 6.283 STEP S
140 A=M
150 FOR F=0.1 TO 0 STEP T
160 IF F>DA THEN 280
170 GOSUB 60
180 X1=2*C*R*COS(A)
190 Y1=C*R*SIN(A)
200 A=M+F
210 GOSUB 60
220 X2=2*C*R*COS(A): IF X2>63 GOTO 370
230 Y2=C*R*SIN(A): IF Y2>23 GOTO 370
240 DX=ABS(X2-X1)
250 DY=ABS(Y2-Y1)
260 IF DX>1 OR DY>1 THEN 280
270 DA=F
280 NEXT F
290 NEXT M
295 REM DRAW GRAPH
310 CLS: FOR A=0 TO 6.283 STEP DA
320 GOSUB 60
330 X1=R*COS(A): Y1=R*SIN(A)
340 X=64+2*C*X1: Y=24-C*Y1: IF X>127
    OR X<0 OR Y>47 OR Y<0 GOTO 370
350 SET (X,Y):NEXT
360 GOTO 360
370 PRINT "SCALE FACTOR TOO BIG": GOTO 50
380 END
```

Line 50: this enables the scale factor to be entered. It is usually larger than unity. For example, in the case of the expression shown in line 60, a scale factor of unity would result in the whole graph being drawn in a single dot in the middle of the screen.

Line 60: the function to be plotted must be typed here before the program is Run. The function shows the relationship between the radius vector R and the angle A.

Line 80: the smaller the increment of A entered, the closer together will be the points in the design.

Lines 110-290: this section of the program calculates the increment of A necessary to ensure a continuous line in the design for the majority of expressions which will be encountered. If you want to use this facility, the input query in line 80 should be answered by pressing Newline or Enter. The variable DA will then fail the test in line 90 and the program will continue with line 110. As this section takes some time to do its sums, line 110 is included to show that something is happening.

Line 310: this lets the independent variable A vary from 0 to 2π. The Video Genie works in radians, not degrees.

Line 330: although we are plotting in polar co-ordinates, computers work in Cartesian co-ordinates, hence the conversions in this line.

Line 240: this introduces the scale factor and sets the pole at the centre of the screen. The Video Genie plots x from left to right and y from top to bottom — the origin is at the top left-hand corner. The grid is 128 wide by 48 high and the graphic elements are higher than they are

(continued on next page)

(continued from previous page)

wide. All of which means that the X1 values have to be multiplied by 2 to keep the proportions right. The addition of 64 to the X1 values puts zero X1 in the centre of the screen. Similarly, the addition of 24 to the Y1 values puts zero Y1 in the centre, and the negative sign ensures that Y increases upwards in the conventional manner. Line 340 also tests if any point lies off the screen and if so asks for a new scale factor at Line 370.

Line 350: this plots the picture.

Line 360: it keeps the picture on the screen until you hit Break.

For a quick start, omit lines 100 to 295. We now have the basic program. Always return to this before typing the variations that follow. Type

```
60 R=SIN(4*A)
```

and Run. Enter 24 for scale factor C and 0.04 for the increment of A (DA). You should have an eight-petalled rose — see figure 1. If you prefer the dots to be closer, reduce DA. There are no axes in polar graphs, but you can add the polar equivalent by plotting the major grid lines, equivalent to A values of 0.5π, π, 1.5π and 2π. Do this by adding lines

```
296 CLS: FOR X=0 TO 127
297 SET (X,24): NEXT
298 FOR Y=0 TO 47
299 SET (64,Y): NEXT
```

and delete the CLS: from line 310.

It is interesting to see the effect of varying the constant in line 60. Do this by

```
50 delete the GOTO 80
55 INPUT "ENTER CONSTANT K"; K: GOTO80
60 R=SIN(K*A)
```

You will find that as the value of K is increased, it is necessary to reduce DA to maintain a reasonable picture, e.g., try with C=24, K=9 and DA=0.03 or K=20 and DA=0.01.

For trigonometric functions such as these — do not omit to try cosines — the graphs tend to stay within bounds. For others, it may be necessary to alter the limits in line 310, and in line 130 if used. For example, try the equiangular spiral:

```
60 R=1.2[A
```

In Video Genie language this means 1.2 raised to the power A.

```
310 CLS: FOR A=0 TO 12.56 STEP DA
```

Run with C=2 and DA=0.2

Care must be taken to avoid divisions by zero as could occur with

```
R=V*CSC(A)+W
```

known as the Conchoid of Nicomedes. In Microsoft Basic, this has to be rewritten in the form:

```
60 R=0.5/SIN(A) +2
```

For values of A near zero, π, and 2π, R becomes very large and the range of A must be restricted:

```
310 CLS: FOR A=0.2 TO 2.94 STEP DA
355 FOR A=3.24 TO 6.18 STEP DA: GOTO 320
```

Run with C=6 and DA=0.05.

Then you could try the Limacon:

```
60 R=0.5-COS(A)
```

with C=20 and DA=0.1 or even the Lituus:

```
60 R=SQR(1/A)
```

for A=0.2 to 15.5, C=20 and DA=0.1. For the best effect with this one, alter the constant 64 in line 340 to 30 to move the graph to the left.

The last example illustrates the ease with which the location of the graph can be altered. By changing the constants 64 and 24 in line 340 and reducing the scale, it is possible to place a graph in a corner while the result of the screen is used for another purpose. Alternatively, different graphs could be put in the four corners.

Hearts and flowers

Making the graph move is not easy if we stick to Basic; it is far too slow. However, if the expression is made simple enough, movement is possible e.g., 60 R=12, with the following alterations.

```
310 CLS: FOR A=0 TO 10000 STEP DA
345 RESET(X2,Y2): X2=X: Y2=Y
```

Run with C=1 and DA=0.4.

We have already seen some flowers. The plots of the sine relationships with which we started are known in the trade as roses. Incidentally, a better-shaped rose with overlapping petals can be obtained by changing:

```
305 CLS: S=0.45: FOR B=0 TO 5.85 STEP S
310 FOR A=0 TO 0.7854 STEP DA
330 X1=R*COS(A+B): Y1=R*SIN(A+B)
355 NEXT B
```

Run with C=22 and DA=0.04

We could try something a little more interesting such as, for example, a dahlia. Let us alter our original program once again:

```
50  INPUT "ENTER SCALE FACTORS"; D,E:
    GOTO 80
55  N=0
60  R=SIN(4*A): RETURN
70  R=COS(4*A): RETURN
305 CLS
310 FOR A=0 TO 6.283 STEP DA
315 IF N=1 C=E: GOTO 328
320 C=D: GOSUB 60
324 GOTO 330
328 GOSUB 70
360 N=1: GOTO 310
```

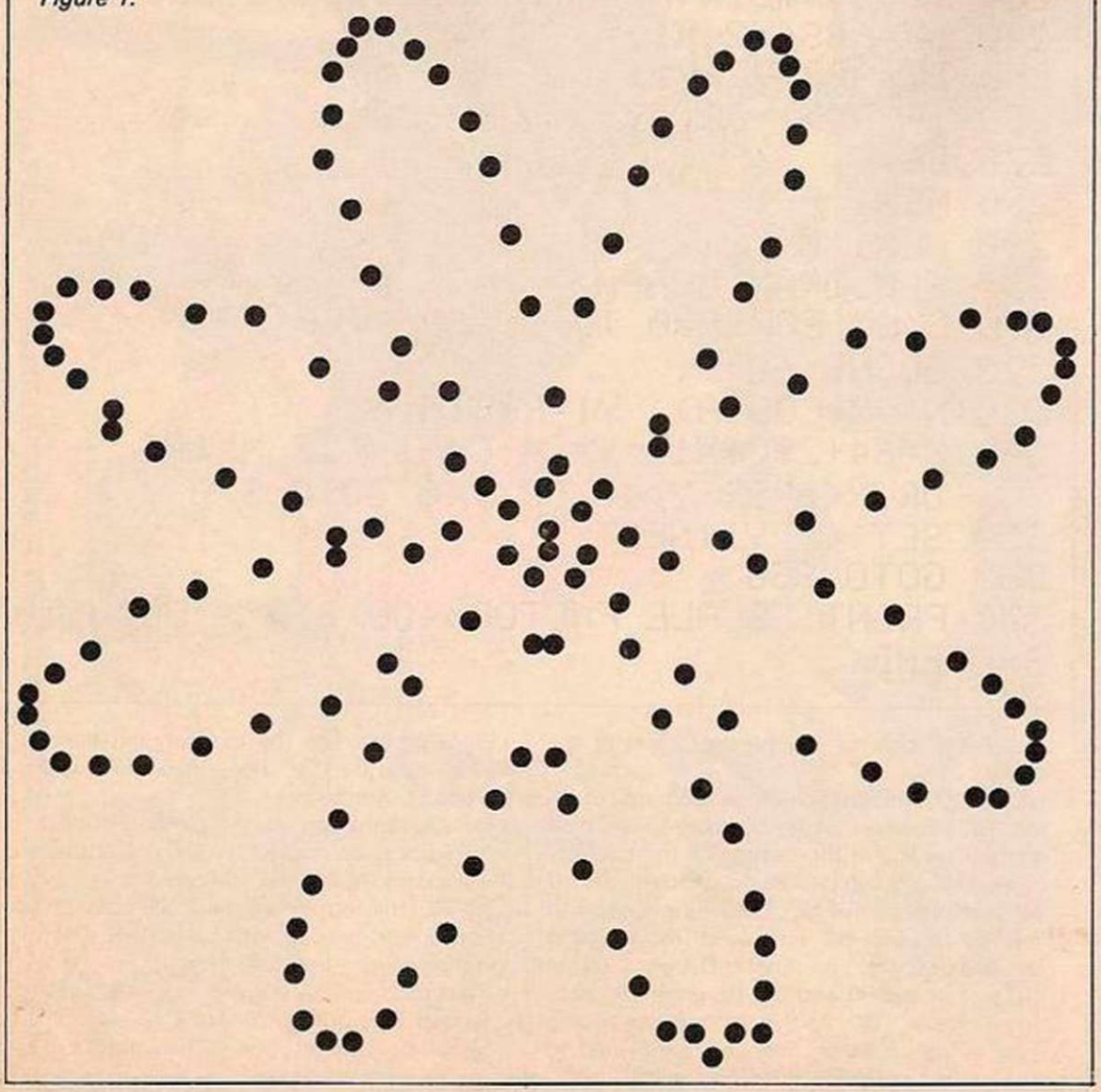
Run and enter scale factors 12,22 and DA 0.02.

What could be better than a cardiod for hearts? Once again, alter the original program:

```
60  R=1-SIN(A)
340 Change the constant 24 to 10
```

Run with C=14 and DA=0.1. ■

Figure 1.



COMBINED FORCES!

South East Computers PLUS Castle Electronics can now offer you Unequalled

Service – at Supermarket Prices!

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 ●**Cassette Deck now available £44.95**

Only £189-95 INC. VAT

You won't find a Better Deal Anywhere in the South

Acorn Atom BRITISH DESIGNED PERSONAL COMPUTER

8K ROM + 2K RAM kit	£140.00	4K Floating Point ROM	£ 23.00
8K ROM + 2K RAM Ass.	£174.50	Colour Encoder	£ 21.85
12K ROM + 12K RAM kit	£255.00	Mains Power Supply	£ 9.20
12K ROM + 12K RAM Ass.	£289.50		

BBC MICRO-COMPUTER NOW IN STOCK PLUS FULL RANGE OF ACCESSORIES

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.

ALL PRODUCTS ARE FULLY GUARANTEED BUY WITH CONFIDENCE

ALL PRICES INCLUDE VAT

ATARI COMPUTERS FOR PEOPLE

FROM £345.00 Plus All Accessories Available!

Model 400 16K	£345.00
Model 800 16K	£645.00
Cassete	£ 50.00
Disk Drive	£345.00
80 Col. Printer	£550.00

COMMODORE PET

8K PET	£458.85
16K PET	£550.00
32K PET	£699.00
Dual Disk Drive	£799.00
Printer	£454.25
External Cassette	£ 44.95

Complete range of 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!

sinclair ZX81 FOR IMMEDIATE DESPATCH £69.99

apple®

BUILT-IN SOUND– HIGH RES. GRAPHICS'

Apple II Plus 48K	£790.00
Disk Drive + Controller	£383.00
D.D. without Cntrller	£303.00
Pascal Card	£264.00
Eurocolour Card	£73.00
Hitachi 9" Monitor	£146.00

We Stock All the Goodies for Apple!

WE SPECIALISE IN COST EFFECTIVE SYSTEMS FOR SMALLER BUSINESSES

ALL PRICES INCLUDE VAT : ACCESS & BARCLAYCARD WELCOME
ORDERS NORMALLY DESPATCHED DAY OF RECEIPT

ASK FOR DETAILS OF OUR TOTAL SUPPORT OPTION

MicroComputers for Business

From Only £19 per week

Package A

SILICON OFFICE SYSTEM

1 x CBM 8096 Computer
1 x CBM 8050 Dual Disk Drive
1 x CBM 8023 Matrix Printer
Connecting cables, plus Silicon Software

From Only £43 per week

Package B

ALTOS MULTI-USER HARD DISK SYSTEM

1 x ALTOS 8000/10 Computer with
10 Mbyte Hard Disk
208Kbyte Memory (4 users)
500Kbyte Floppy Disk Drive
2 x TVI 912C VDU's
1 x OKI Microline 83A Printer

SEC BUSINESS SYSTEMS SUPPLY A WIDE RANGE OF EASY-TO-OPERATE SYSTEMS AND PROGRAMMES TO MEET ALL OF TODAYS BUSINESS NEEDS + FULL RANGE OF COMPUTER RELATED PRODUCTS + LEASING AGREEMENTS + FULL AFTER SALES SERVICE

ALL PERSONAL COMPUTER ENQUIRIES:– Contact Paul Brown or Sam Wright on Hastings (0424) 437875 (Formerly Castle Electronics)

FOR ALL BUSINESS SYSTEMS ENQUIRIES:– Phone Nick Rosenberg on Hastings (0424) 426844

SEC *The Complete Computer Service!*

15 CASTLE STREET, HASTINGS, EAST SUSSEX TN34 3DY DEPT. YC3

RS-232

PERIPHERAL INTERFACE

The RS-232 port on the Vic is the machine's main communications route to the outside world. Through this serial I/O port, the Vic can interface with peripherals such as printers and Modems. Nick Hampshire unravels the technicalities.

A SERIAL I/O port can consist of as few as three lines: an output or transmit line, an input or receive line and a common ground line. The data is transmitted or received as a stream of pulses and a single byte becomes a string of eight pulses. The format of such a serial bit stream is shown in figure 1.

Although a serial port may have just three lines, other lines are frequently used to transfer control information. The Vic can receive and generate control signals to implement a full X-line interface as well as the simple three-line one.

Whichever implementation is used, all the lines are connected to I/O port B of VIA # 1 — the same lines used for the user port. Normally an RS-232 interface card will be used to connect between the parallel port and a standard RS-232 connector. The card will also provide buffering and a higher drive voltage.

For communications using the simple three-line mode, an interface card can easily be constructed using two buffer/driver integrated circuits. The RS-232 line normally transmits data using a 12V signal. Providing cables are kept short, however, it will work with a 5V signal. The line connections to the VIA are shown in figure 2, and the standard RS-232 connector is shown in figure 3. The function and pin assignment of each of these lines is shown in table 1.

The implementation of the RS-232 port on the Vic involves the use of software to emulate a hardware device. The hardware is the 6551 Universal Asynchronous Transmitter and Receiver or UART.

The Vic designers originally intended to use this chip to generate the RS-232 I/O. However, MOS was unable to deliver the devices in time for the Vic production, and software emulation had to be employed.

An exact emulation of the function of the 6551 is used since it allows the manufacturer to change the Vic hardware design to incorporate the 6551 as soon as this device becomes available.

Like the other I/O chips, the 6551 functions are controlled by registers at specific memory locations. The pseudo-6551 registers are located in various parts of the variable storage area at the bottom of Vic memory. Besides the registers, the RS-232 operating routines require two 256-byte buffers; one for receive data and the other for transmitted data.

The 512 bytes of memory occupied by these buffers is located at the top of available RAM memory and the starting address of the two buffers is stored in four register bytes. The two most important registers are the control and command. They determine the exact operation of the RS-232 port and can be summarised as follows.

The function of the pseudo-6551 control register — $0293 hexadecimal, 659 decimal — is to set the speed of data transmission and reception, and stipulate the number of bits needed to transmit each character. The speed at which data is input or output is called the baud rate, and it describes the number of bits transmitted per second.

If the baud rate is set to 300 baud and each character is transmitted at eight character bits plus one stop bit and one parity bit — a total of 10 bits — then 30 characters will be transmitted every second.

The selected baud rate depends on the specifications of the device communicating with the Vic via the RS-232 port. Check the manual of the device before setting this value. Bits 5, 6 and 7 control the number of bits needed to transmit or receive data between the Vic and a peripheral. The number of bits per character plus the number of stop bits depend on the device communicating with the Vic via the RS-232 port.

The pseudo-6551 command register — $0294 hexadecimal, 660 decimal — controls the mode of data transmission and reception. Bit 0 sets the mode, a three-line mode or a X-line mode. Bit 4 sets the duplex mode as follows:

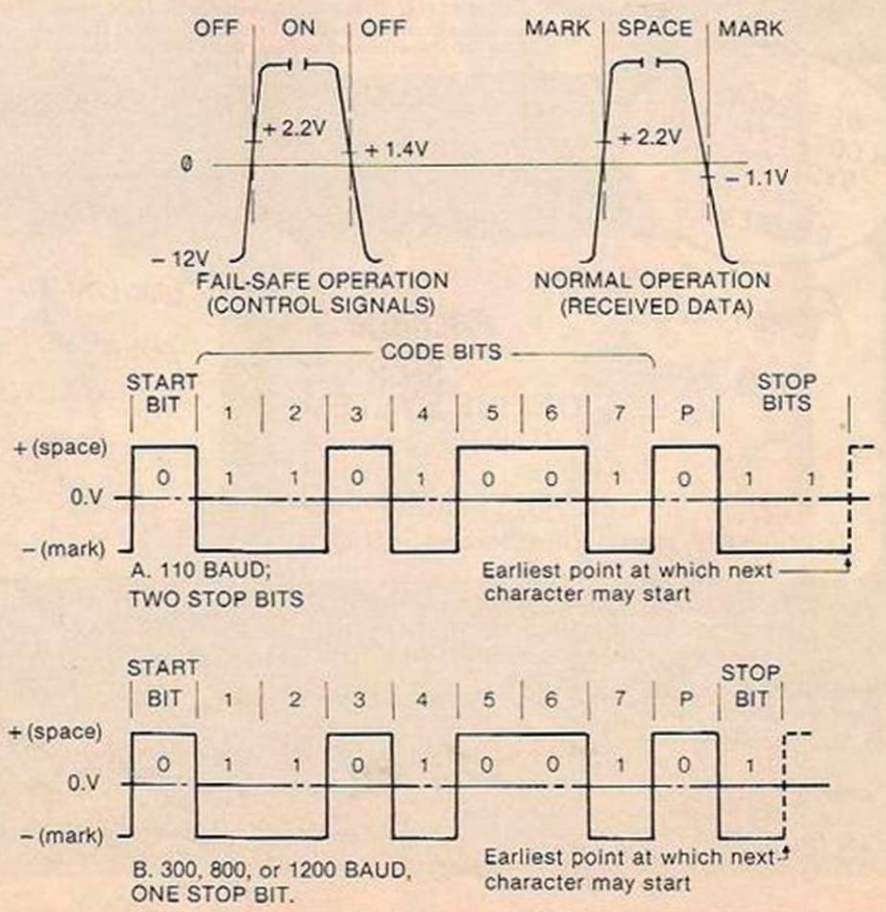
Full duplex — simultaneous transmission and reception of data.
Half duplex — alternate transmission and reception of data.

Table 1.

VIA line	RS-232 pin	VIA pin	Abbreviation
GND	1	A	GND
CB1	3	B	Sin
PB0	3	C	Sin
PB1	4	D	RTS
PB2	20	E	DTR
PB3	18	F	RI
PB4	8	H	DCD
PB6	5	K	CTS
PB7	6	L	DSR
CB2	2	M	Sout
GND	7	N	GND

Modes:
1 — Three-line interface — RTS and DTR are both held high during this mode.
2 — X-line interface.

Figure 1. Data format on the ASCII interface.



OF VIC-20 PORT

Bits 5, 6 and 7 determine the nature of the parity bit and whether the mark or space is transmitted. The parity bit is transmitted after the data bits and has an error-checking function.

The choice of whether the parity is disabled or is set to odd or even depends on the specification of the communicating device attached to the Vic RS-232 port. The mark/space setting determines whether a logic 1 is transmitted as a zero voltage or a positive voltage. This is shown in figure 1.

The RS-232 status register is $0297 hexadecimal, 663 decimal. The other memory locations and pseudo-6551 registers are as follows:

$A7 — receiver input-bit temporary storage
$A8 — receiver bit count in
$A9 — receiver flag start-bit check
$AA — receiver byte buffer or assembly location
$AB — receiver parity-bit storage
$B4 — transmitter bit count out
$B5 — transmitter next bit to be sent
$B6 — transmitter byte buffer/disassembly location
$F7-$F8 — a two-byte pointer to the receiver buffer-base location
$F9-$FA — a two-byte pointer to the transmitter buffer-base location
$0298 — the number of bits to be sent or received
$0299-$029A — the time for transmission of one bit cell based on system clock or baud rate
$029B — the byte index to the end of the receiver FIFO buffer
$029C — the byte index to the start of the receiver FIFO buffer
$029D — the byte index to the start of the transmitter FIFO buffer
$029E — the byte index to the end of the transmitter FIFO buffer

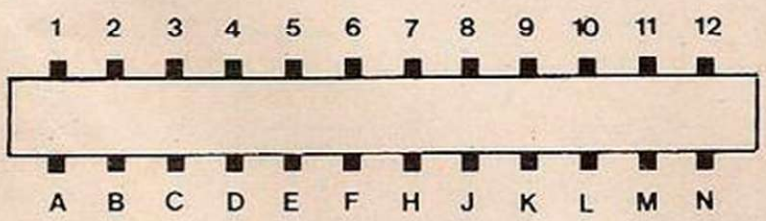
Here are the RS-232 system-routine entry points:

$EFA3 — entry for NMI-continue routine
$EFBF — calculate parity, $B5 = 0 upon entry
$EFE8 — count stop bits
$EFEE — entry to start of byte transmission
$EFFB — set up to send next byte
$F016 — set errors
$F027 — calculate number of bits to be sent, returns number of bits + 1
$F036 — NMI routine to collect data into bytes
$F040 — calculate parity
$F046 — shift data bit in
$F04B — have stop bit so store in buffer
$F05B — enable to receive a byte
$F068 — receiver start bit check
$F06F — put data in buffer at parity times
$F08B — parity checking
$F094 — check calculated parity
$F09F — errors reported
$F0BC — output a file over user port using RS-232
$F0C4 — check for DSR and RTS
$F0CD — check for active input; RTS will be low if currently inputting
$F0D4 — wait for CTS to be off
$F0D9 — turn on RTS
$F0E1 — wait for CTS to go on
$F0ED — buffer handler to output a character
$F0FC — set up if necessary to output
$F102 — set up for a first byte out
$F10E — set up for T1 NMIs
$F116 — input a file over user port using RS-232
$F122 — check if DSR and not RTS
$F12B — wait for active output to be done
$F130 — turn off RTS
$F138 — wait for DCD to go high
$F13F — enable CB1 for RS-232 input
$F146 — if not three-line half, then see if we need to turn on CB1
$F14F — input a character buffer handler
$F15C — receiver always runs
$F160 — protect serial/cassette from RS-232 NMIs

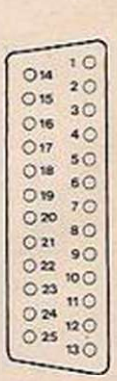
EIA	In/ Out	Modes	Function
AA	—	1,2	Protective ground
BB	In	1,2	Received data
BB	In	1,2	Connected to Sin
CA	Out	2	Request to send
CD	Out	2	Data terminal ready
CE	In	3	Ring indicator
CF	In	2	Received line signal
CB	In	2	Clear to send
CC	In	2	Data set ready
BA	Out	1,2	Transmitted data
AB	—	2,3	Signal ground

3 — User available only and not implemented or used in the Vic RS-232 code.

Figure 2. User I/O.



PIN #	TYPE	NOTE	PIN #	TYPE	NOTE
1	GND		A	GND	
2	+5V	100mA MAX.	B	CB1	
3	RESET		C	PB0	Sin
4	JOY0		D	PB1	RTS
5	JOY1		E	PB2	DTR
6	JOY2		F	PB3	RI
7	LIGHT PEN		H	PB4	DCD
8	CASSETTE SWITCH		J	PB5	
9	SERIAL ATN IN		K	PB6	CTS
10	9VAC		L	PB7	DSR
11	9VAC		M	CB2	Sout
12	GND		N	GND	



PIN		TalCo	CCITT
1	Protective Ground	AA	101
2	Transmitted Data	BA	103
3	Received Data	BB	104
4	Request to Send	CA	105
5	Clear to Send	CA	105
6	Data Set Ready	CC	107
7	Signal Ground	AB	102
8	Carrier Detect	CF	109
9	(not used)		
10	(not used)		
11	(not used)		
12	(not used)		
13	(not used)		
14	(not used)		
15	(not used)		
16	(not used)		
17	(not used)		
18	(not used)		
19	(not used)		
20	Data Terminal Ready	CD	108
21	(not used)		
22	(not used)		
23	(not used)		
24	(not used)		
25	(not used)		

Figure 3. Serial I/O cable connector pins.

The Basic syntax for opening an RS-232 channel is:

OPEN # lf, 2, 0, "<control register><command register>"

lf is the normal logical file ID — 1 to 255. If lf is less than 127 then line feed follows carriage return. <control register> is an ASCII character equivalent to the required bit setting of the control register. For example, to set baud rate to 300 and transmit seven-bit code, use CHR$(6+32). This sets bits 1,2 and 5 to logic 1 and leaves the rest at logic 0.

<command register> is an ASCII character equivalent to the required bit setting of the command register. For example, to set the output to mark parity and full duplex, use CHR$(32+128). This sets bits 5 and 7 to logic 1 and leaves the rest at logic 0.

The machine-code entry point is $FFC0 hexadecimal. Only one RS-232 channel should

(continued on next page)

(continued from previous page)
be open at any time. The Open statement resets the buffer pointers, so a second Open will destroy any data in the buffers set up in the first Open.

The Open RS-232 channel command should be used before any variable or Dim statements. Failure to do this will mean the data is wiped. This is because the Open RS-232 channel command performs an automatic CLR before allocating the 512 bytes at the top of memory used for the two RS-232 data buffers.

If there is insufficient space at the top of memory for the 512-byte buffer, the program will be destroyed. The file-name field in the Open command statement can have up to four characters, only two characters are currently used by the system. The other two characters are for future systems options.

No error-checking is performed by the system on the contents of the control or command characters and errors in baud-rate selection will cause system malfunction. A non-implemented baud rate will cause an index to bad-page data, and output will be set to a rate below 50 baud.

To receive data from an RS-232 channel, use the Basic syntax

GET # lf, <string variable>

lf represents the logical file ID used in the Open RS-232 channel command.

The machine-code Entry Points are $FFC6 which means open channel for input. It

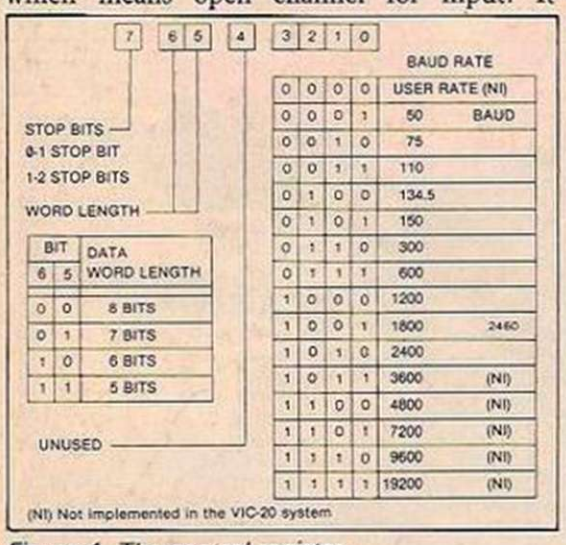


Figure 4. The control register.

handles the full X-line implementation according to EIA standard RS-232C interfaces. The RTS, CTS and DCD lines are implemented when the Vic is designated as a data terminal device. $FFE4 means take a character from the buffer.

Received data is put into the Vic's 255-byte internal receiver buffer set up during the Open RS-232 channel command. Data input is under the control of the 6522 timers and interrupts, and is performed in the background when a Basic program is run.

This is done by having the RS-232 data-input line connected to the CB1 handshake line. An input on CB1 will generate an NMI system interrupt. The use of NMI interrupts is the reason why the cassette and serial bus should not be used during RS-232 data communications.

The NMI interrupt will call the serial data-input routines whenever data is present on the RS-232 input. These routines place the

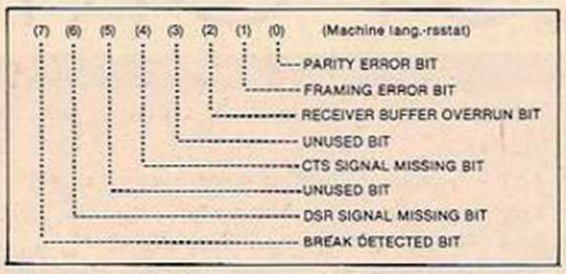


Figure 5. RS-232 status register.

received data into the 255-byte receiver buffer located at the top of RAM memory. If the input data has a word width less than eight bits, then all unused bits will be filled with zero.

The receiver buffer is organised as a first-in first-out — FIFO — buffer. The buffer removes the necessity for Basic to wait for data input before processing each byte of data. Instead, the Basic program can take data from the buffer when it needs it, rather than when it is presented.

Basic accesses the buffer, using the Get command to transfer a single byte of data into a Basic variable. If there is no data in the buffer, then the Get# command will return with a null character. If the buffer should overflow, all characters received during the overflow condition are lost, an overflow condition is indicated by bit 2 in the RS-232 status register being set.

Overflow will frequently occur, if an attempt is made to input data at relatively high data rates using Basic. This is because Basic is normally slow, and the use of the Get command with string concatenation will result in garbage. Machine-language routines are best used for data rates above the normal 300 baud.

To transmit data to an RS-232 channel, use the Basic syntax:

CMD lf
PRINT # lf + <variable list>

lf is the logical file ID, set up in the Open RS-232 channel command. The machine-code entry points are $FFC9 which means open channel for output. This handles X-line handshaking for the implementation of an EIA standard RS-232 interface. The RIS, CTS, and DCD lines are implemented with the Vic as a data terminal. $FFD2 means output character to channel.

When either one of the two Basic commands are used, data is first transferred from the assigned string or memory block to the 255-byte transmitter buffer. From here, it is output to the RS-232 channel using the format and baud rate assigned in the Open RS-232 channel command.

Data output is transparent to the operation of Basic since the timing is done by the 6522 timers and output of each byte initiated by an NMI system interrupt.

As with data input on the RS-232, the cassette or serial IEEE port should not be used during data transmission. If it is, interrupt conflicts will occur. No carriage-return delay is implemented by the output channel. Therefore, a normal RS-232 printer cannot correctly output the data, unless some form of internal buffering is implemented by the printer.

If a CTS handshake is implemented — in the X-line mode — then the Vic buffer will fill, and output will not occur until transmission is allowed by an input on CTS.

To close an RS-232 data channel, use the Basic syntax:

CLOSE lf

lf is the logical file ID set-up in the Open RS-232 channel command. The machine-code

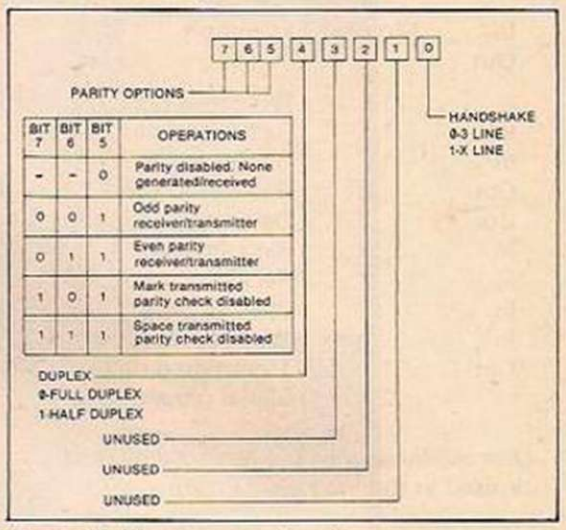


Figure 6. The command register.

Entry Point is $FFC3, which means close the logical file.

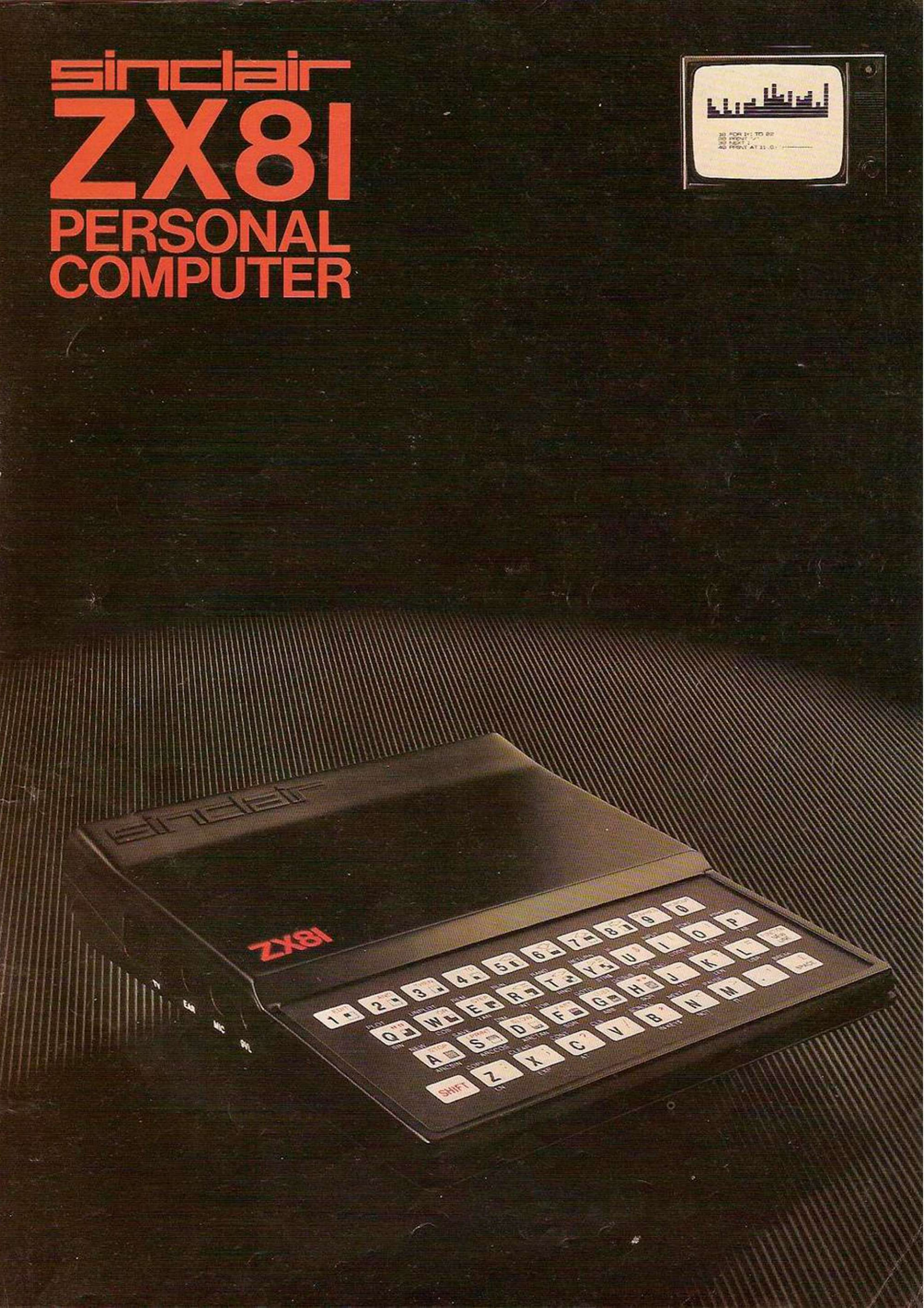
Closing the RS-232 file causes all the data in the buffers to be discarded. It stops data transmission or reception, sets the RTS and Sout lines high, and de-allocates the memory area used for the RS-232 buffers. Closing the RS-232 file will also allow the cassette or serial IEEE ports to be used.

Before closing the channel, care should be taken to ensure that all data in the buffer is transmitted. This can be done by checking the status — the ST variable is equal to 0 — and that bit 6 of parallel port A of VIA # 1 location 37151 is set to logic 1. If both are true then there is still data in the buffer. ■

A sample Basic program.

```
  RS232 SERIAL COMMUNICATIONS
   5 SAMPLE BASIC PROGRAM (BY PERMISSION OF CBM)
  10 REM THIS PROGRAM SENDS AND RECEIVES DATA TO/FROM
     A SILENT 700 TERMINAL
  20 REM TI SILENT 700 SET-UP: 300 BAUD, 7-BIT ASCII,
     MARK PARITY, FULL DUPLEX
  30 REM SAME SET-UP AT COMPUTER USING 3-LINE INTERFACE
 100 OPEN 2,2,3,CHR$(6+32)+CHR$(32+128): REM OPEN THE
     CHANNEL
 110 GET#2,A$: REM TURN ON THE RECEIVER CHANNEL (TOSS
     A NULL)
 200 REM MAIN LOOP
 210 GET B$: REM GET FROM COMPUTER KEYBOARD
 220 IF B$<>"" THEN PRINT#2,B$;: REM IF A KEY PRESSED,
     SEND TO TERMINAL
 230 GET#2,C$: REM GET A KEY FROM THE TERMINAL
 240 PRINT B$;C$;: REM PRINT ALL INPUTS TO THE
     COMPUTER SCREEN
 250 SR=ST: IF SR=0 THEN 200: REM CHECK STATUS, IF
     GOOD THEN CONTINUE
 300 REM ERROR REPORTING
 310 PRINT "ERROR: ";
 320 IF SR AND 1 THEN PRINT "PARITY"
 330 IF SR AND 2 THEN PRINT "FRAME"
 340 IF SR AND 4 THEN PRINT "RECEIVER BUFFER FULL"
 350 IF SR AND 128 THEN PRINT "BREAK"
 360 IF (PEEK(37151) AND 64)=1 THEN 360: REM WAIT
     UNTIL ALL CHARS TRANSMITTED
 370 CLOSE 2: END
```

sinclair ZX81 PERSONAL COMPUTER



Sinclair ZX81 Personal Compu
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!

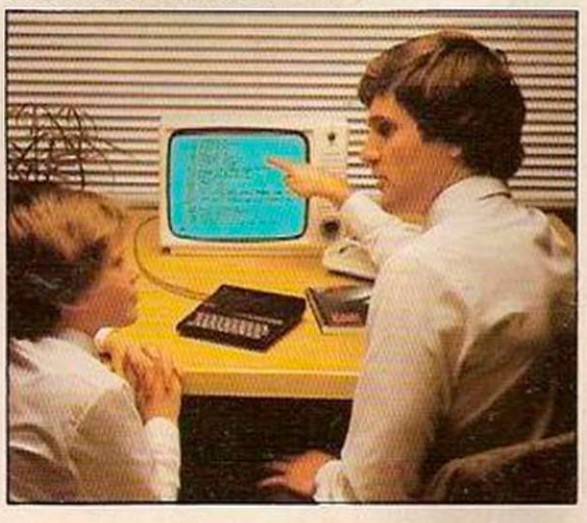
New, improved specification

- 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, FREEPOST, Camberley, Surrey, GU15 3BR. **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. YOC 03

sinclair

ZX81

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

How the ZX81 compares with other personal computers

SYSTEM IDENTIFICATION		ZX81	ZX80	ACORN ATOM	APPLE II PLUS	PET 2001	TRS 80 LEVEL I	TRS 80 LEVEL II
ROM		8K	4K	8K	8K	14K	4K	12K
GUIDE PRICE	Basic unit – inc. VAT	£70	£100	£175	£630	£435	£290	£375
	Unit plus 16K RAM (*12K RAM)	£120	£150	£285*	£630	£530	£360	£375
COMMANDS	LIST, LOAD, NEW, RUN, SAVE	●	●	●	●	●	●	●
STATEMENTS	PRINT, INPUT, LET, GOTO, GOSUB/RETURN, FOR/NEXT IF/THEN	●	●	●	●	●	●	●
	STEP	●		●	●	●	●	●
	TAB	●			●	●	●	●
ARITHMETIC	ABS, RND	●	●	●	●	●	●	●
FUNCTIONS	INT	●			●	●	●	●
	ATN, COS, EXP, LOG, SGN, SIN, SQR, TAN	●			●	●		●
	ARCSIN, ARCOS	●						
STRING	CHR$	●	●		●	●		●
FUNCTIONS	LEN	●		●	●	●		●
	ASC(CODE), STR$, VAL, INKEY$	●				●		●
NUMBERS	FLOATING PT $\pm 10^{\pm 38}$	●			●	●	●	●
	INTEGERS		●	●	●	●		●
NUMERIC	A-Z			●			●	
VARIABLES	AA-ZØ				●	●		●
	An-Zn, n = any alphanumeric string	●	●					
STRING	A$ & B$						●	
VARIABLES	A$ to Z$	●	●	●				
	An$ to Zn$ n = any alphanumeric character				●	●		●
NUMERIC	SINGLE DIMENSIONAL		●	●			●	
ARRAYS	MULTI DIMENSIONAL	●			●	●		●
DISPLAY	ROWS	24	24	16	24	25	16	16
	COLUMNS	32	32	32	40	40	64	64
	LOW RES GRAPHICS (<7000 pixels)	●	●	●	●	●	●	●
	HI RES GRAPHICS (>40000 pixels)			●	●			
SPECIAL	USR (CALL, LINK)	●	●	●	●	●		●
FEATURES	PEEK, POKE (OR EQUIV)	●	●	●	●	●		●

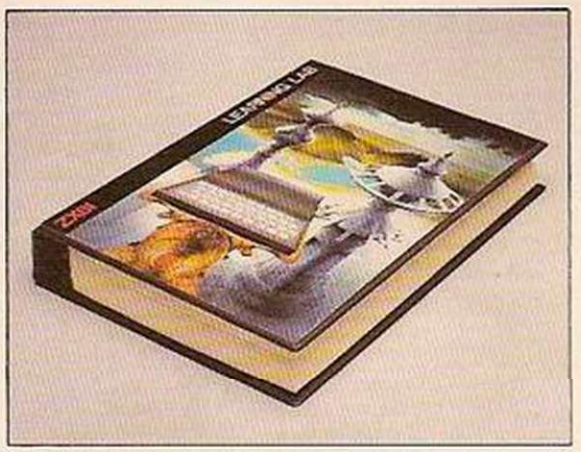
Sinclair software on cassette.

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 others to form single-subject cassettes.

Software currently available includes games, junior education, and business/household management systems. You'll receive a Sinclair ZX Software catalogue with your ZX81 – or see our separate advertisement in this magazine.

The ultimate course in ZX81 BASIC programming.



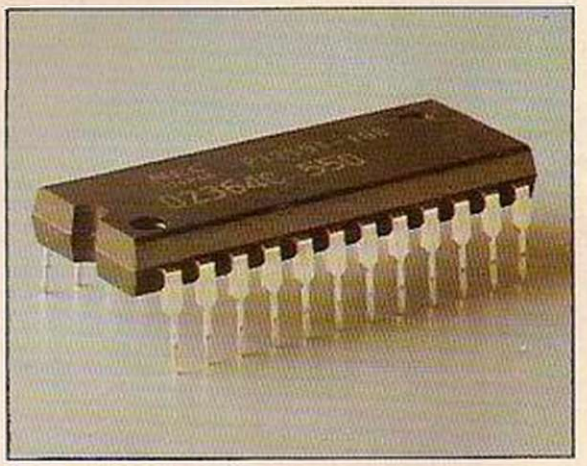
Some people prefer to learn their programming from books. For them, the ZX81 BASIC manual is ideal.

But many have expressed a preference to learn *on* the machine, *through* the machine. Hence the new cassette-based ZX81 Learning Lab.

The package comprises a 160-page manual and 8 cassettes. 20 programs, each demonstrating a particular aspect of ZX81 programming, are spread over 6 of the cassettes. The other two are blank practice cassettes.

Full details with your Sinclair ZX81.

If you own a Sinclair ZX80...



The new 8K BASIC ROM used in the Sinclair ZX81 is available to ZX80 owners as a drop-in replacement chip. (Complete with new keyboard template and operating manual.)

With the exception of animated graphics, all the advanced features of the ZX81 are now available on your ZX80 – including the ability to drive the Sinclair ZX Printer.

sinclair
ZX81

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

FROM GAMES STRATEGY INTO ACTION

With this complete noughts and crosses program, Boris Allan puts into practice the logical and strategic processes discussed last month.

NOUGHTS AND CROSSES, or tic-tac-toe, is a game which is older than at least some of the hills. It is a game of symmetries, and regularities, and so should eminently suit a programmable solution. There seems to be a common fault with novice programmers: in attempting to make the program as physcially short as possible, they often ignore the run-time efficiency or give it too low a priority.

A little thought about the structure of the problem can improve the final structure of a program. I am not advocating structured programming or anything so esoteric, and I am not suggesting any rules to be followed which will produce perfect bug-free programs — partly because such rules do not exist — but I am suggesting some prior thought.

The program is written in Atom Basic, because it is a small computer to hand, with excellent graphics. In any case, when the design of the program is discussed the language, and the computer, are not important. Thinking about the problem, noting certain key points, I made some written elaborations of what the points implied about the structure of the problem.

Two people play the game. Since one person is X and the other is O, why not let O be given the internal code 1 and X the code −1? The ASCII value for the character 0 is 79, and for X it is 88. So, if the code is P the correct character is given by the ASCII value

(9*(1-P)/2 + 79)

That is, if P= +1 then the value is 79, and if P = −1 then the value is 88. In one program I have seen, there are statements of the form

```
1000 IF P=1 THEN C$ = "O"
1010 IF P=-1 THEN C$ = "X"
```

or

```
2000 IF P=1 GOTO 2030
2010 PRINT "X"
2020 GOTO 2040
2030 PRINT "O"
2040 REM +CONTINUE+
```

and those I have labelled 1000 onwards are redundant, whereas the lines 2000 onwards could all be compressed to the one line written in a special variant of Basic:

```
2000 PRINT CHARACTER(9*(1-P)/2 + 79)
```

It would seem sensible to choose the person who is to start by random methods — though the players could choose.

The board has nine elements, and it would be reasonable to label the cells in some regular way. If R is the row number — 0,1,2 — and C is the column number — 0,1,2 — then the board could be described as in figure 1 where the first number is the row, and the second number is the column. In any program this regularity should be utilised as far as possible.

It is clear that the same square cannot be used twice: the squares need to be set at the start to a blank value, say, zero internally in the program. A check needs to be made to see if an entry has already been made in the square chosen by the player. If the square is not blank, the user has to re-enter a value. If the square is blank, an O or X can then be entered 1 or −1, internally.

The board needs to be sent to the output device, either as text or by use of graphics. Again the regularity of the board is important in this.

No lines need to be checked until five squares have been entered, and only lines through the last square need to be checked. This highly important way of decreasing the amount of work to be done was ignored in the program I examined. For each entry or move all eight lines on the board were checked — that is, three horizontal, three vertical, and two diagonal. For example: in cell 0,1 only row 0 and column 1 need be checked; whereas for cell 2,0 row 2, column 0, and the forward diagonal — 2,0 to 0,2 — need to be checked.

Only one marker is needed, i.e., P : P will be either +1 or −1 — for O or X — on each turn, so somewhere we will need to write P=−P to change sign. There is no need to keep 0 or X in any stored location, because we can use the information that the ASCII code is

(9*(1-P)/2 + 79)

The value of P to start can be set by a random number generator. Either the board can be represented internally by a one-dimensional array of nine elements — ranging from 0 to 8 — or it can be represented as a two-dimensional array of nine elements, ranging from 0 to 2 by 0 to 2.

If a one-dimensional array is used: the row R, corresponding to element number E is given by

R = TRUNC(E/3)

That is, E divided by 3 ignoring the remainder. The column, C, is given by

C = E MODULO 3

That is, the remainder when E is divided by 3.

All elements of whatever array is chosen

(continued on next page)

```
    1 REM XOX
    2 REM
    3 REM A PROGRAM FOR THE ATOM
    4 REM
    5 REM BY
    6 REM G J BORIS ALLAN
    7 REM
    8 REM
1000 REM INITIALISATION
1010 DIM BB(8);FOR I=0 TO 8;BB(I)=0;
     NEXT I
1020 P=RND%2;IF P=0 GOTO1020; REM I
     DO NOT USE ATOM LABELS
1030 CLEAR0;PRINT $30''"XOX PROGRAM"
     ''"RANDOM START"'''
1040 PRINT $(9*(1-P)/2+79)" STARTS"
     '''';REM '$' GIVES CHARACTER
1050 INPUT"READY "$I
1060 GOSUB 10000;REM SET-UP BOARD
1500 FOR I=1 TO 9;REM LOOP
2000 REM INPUT
2010 PRINT $7$21;INPUT D;PRINT $6;
     REM BUZZ, ACCEPT CO-ORDINATE
2020 D=D-1;IF D<0 OR D>8 GOTO 2010;
     REM 'D' IN LEGAL RANGE ?
```

(listing continued on next page)

(continued from previous page)
must be set to zero. On input of the co-ordinate of a cell, a check has to be made to ensure that the co-ordinate is within the correct range. Then, if the co-ordinate is admissible, a check has to be made that the cell has not been used before. If all is correct, then the value of P is entered into the correct cell.

I made a decision to use graphics for output of the play, and noted that the graphics output could be split into two parts. First, drawing the board, and, second, displaying the Os and Xs. The first part is trivial. In the second part there are the two basic shapes, O and X, so it would be sensible to define these two shapes, and then the symmetry of the board could be used to place them in the appropriate positions. Take a graphics command

DRAW FROM 0,0 TO 2,2

in some programming language, and the result will be a short diagonal line starting at the origin. The instruction

DRAW FROM (X+0),(Y+0) TO (X+2),(Y+2)

will produce a short diagonal line — parallel to the first — starting in this case at the point X,Y. The values of X and Y in the second Draw instruction are offsets — that is, they indicate where the shape is placed relative to the origin. In graphics routines for O and X, the incorporation of off-sets will mean that these shapes can easily be drawn at any position. The regularity of the board helps here.

For row R and column C, the cell for a two-dimensional array will be isolated by the indices R,C, and for a one-dimensional array the single index 3*R + C will isolate the correct cell. The checks are then simple to arrange.

All the cells for row R are given by the indexes R,0 and R,1 and R,2 for a two-dimensional array. The cells for column C are 0,C and 1,C and 2,C — with equivalents for one-dimensional arrays.

A cell on the forward diagonal is 2,0 and 1,1 or 0,2, so if R+C=2 for the last cell to be entered, then the forward diagonal needs checking. For the backward diagonal 0,0 and 1,1 or 2,2, so R=C for this diagonal to be checked. The diagonals need not be checked if

0 0 Cell 0	0 1 Cell 1	0 2 Cell 2
1 0 Cell 3	1 1 Cell 4	1 2 Cell 5
2 0 Cell 6	2 1 Cell 7	2 2 Cell 8

Figure 1.

R+C is odd, that is, 0,1 and 1,0 and 1,2 or 2,1.

The sequence of control in noughts and crosses can be shown as

1 INITIALISATION
1.5 LOOP — up to nine times
2 INPUT
3 DISPLAY
4 WINNER CHECK — if win exit to (5.1)
4.5 ENDLOOP
5 DRAW and end
5.1 WIN and end

In section 1 an array is dimensioned, and all elements are set to zero. A decision is then made on who is to start and the blank board is drawn. Section 2 allows a move to be entered, and if the move is illegal asks for new input. The move is displayed on the output device — section 3 — before a check is made for a winning line in section 4. There are three possible outcomes, no win and board full — a draw — no win and board not full — next input — or a win and exit from loop.

The modularity of this outline, together with the description of the algorithm, should assure its easy implementation on various machines, and the example I use is the Acorn Atom. Once the program has been written, it is possible to optimise by all kinds of criteria, but no such attempt has been made with the example program.

All this shows how a little thought can achieve greater gains in efficiency than mere space cramming: the best way of having an effective program is by having an effective, well thought out structure — strive for simplicity and efficiency will follow.

Noughts and crosses has been used as an example of how it is possible to design a program in a systematic way, but as it is possible to answer even simple questions in different ways, here is a different answer. Suppose we draw a Magic Square

2 7 6
9 5 1
4 3 8

in which all lines total to 15. To check for a win, all we need do is find whether — for the latest move — any combination of three scores total to 15, always including the score for the latest move.

Each player has up to five possible moves, and so a five-element array will be needed for each person — as will an array to hold the Magic Square. A simple checking procedure might be

```
WIN = 0
CRITERION = 15 - A(MOVE)
FOR J = 2 TO MOVE - 1
SUBCRITERION = CRITERION - A(J)
FOR K = 1 TO J - 1
IF A(K) = SUBCRITERION THEN WIN = 1
NEXT K
NEXT J
REMARK IF WIN IS 1 THEN THERE IS A WIN
```

(listing continued from previous page)

```
2030 IF BB(D)<>0 GOTO 2010;REM IS
     CELL EMPTY ?
2040 R=D/3;C=D%3;BB(D)=P;REM 'R' IS
     ROW, 'C' IS COLUMN
3000 REM DISPLAY
3010 GOSUB 11000;REM GRAPHICS SHAPE
     ROUTINE
3020 FOR J=1 TO 60;WAIT;NEXT J;
     REM LET THEM SEE IT
4000 REM WINNER CHECK
4010 P=-P; IF I<5 GOTO 4500;REM
     DON'T BOTHER LESS THAN 5
4020 IF BB(R*3)+BB(R*3+1)+BB(R*3+2)
     =-P*3 GOTO 5100;REM ROW CHECK
4030 IF BB(C)+BB(C+3)+BB(C+6)=-P*3
     GOTO 5100;REM COLUMN CHECK
4040 IF (R+C)%2=1 GOTO 4500;REM NOT
     ON DIAGONAL
4050 IF R+C<>2 GOTO 4080;REM NOT ON
     FORWARD DIAGONAL
4060 IF BB(2)+BB(4)+BB(6)=-P*3 GOTO
     5100
4070 IF R<>C GOTO 4500;REM NOT ON
     BACKWARD DIAGONAL
4080 IF BB(0)+BB(4)+BB(8) GOTO 5100
4500 NEXT I;REM ENDLOOP
5000 REM DRAW
5010 CLEAR0;PRINT $6$30''"GAME IS
     DRAWN"'''';END
5100 REM WIN (FOR-P)
5110 CLEAR0;PRINT $7$7$7$7'''
     $(9*(1+P)/2+79)" WINS"$7'''''''
 5120 END
10000 REM DRAWS 'BOARD'
10010 CLEAR0
10020 MOVE16,0;DRAW16,48;MOVE32,0;
     DRAW32,48;REM VERTICAL LINES
10030 MOVE0,16;DRAW48,16;MOVE0,32;
     DRAW48,32;REM HORIZONTAL LINES
10040 RETURN
11000 REM DRAWS SHAPES (48X48 BOARD)
11010 X=C*16+8;Y=40-R*16;IF P=-1 GOTO
     11040;REM WHICH SHAPE ?
11020 MOVE(X+5),(Y+5);DRAW(X-5),Y;
     DRAWX,(Y-5);DRAW(X+5),Y
11030 DRAWX,(Y+5);RETURN;REM '0' SHAPE
11040 MOVE(X+5),(Y+5);DRAW(X-5),(Y-5)
11050 MOVE(X+5),(Y-5);DRAW(X-5),(Y+5);
     RETURN;REM 'X' SHAPE
```

Lack of ZX81 memory giving you headaches..?

The Memotech 64K Memopak

The growth of interest in computer use caused by the introduction of the Sinclair ZX81 has made new and exciting demands on the ingenuity of electronic engineers. At Memotech we have focused our attention on the design of an inexpensive, reliable memory extension.

The Memopak is a 64K RAM pack which extends the memory of the ZX81 by a further 56K. Following the success of our 48K memory board the new memory extension is designed to be within the price range expected by Sinclair users. It plugs directly into the back of the ZX81 and does not inhibit the use of the printer or other add-on boards. There is no need for an additional power supply or for leads.

The Memopak together with the ZX81 gives a full 64K, which is neither switched nor paged, and is directly addressable. The unit is user transparent and accepts such basic commands as 10 DIM A(9000)

0-8K ...Sinclair ROM
8-16K...Memopak memory which can switch in or out in 4K blocks to leave space for memory mapping.
12-16K...Memopak memory which holds its contents during cassette loads and allows communication between programmes.
16-32K...This area can be used for basic programmes and assembly language routines.
32-64K...32K of RAM memory for basic variables and large arrays.

64K-£79

With the Memopak extension the ZX81 is transformed into a powerful computer, suitable for business, leisure and educational use, at a fraction of the cost of comparable systems.

MEMOTECH

Memotech Ltd
3 Collins Street
Oxford · OX4 1XL
Tel · 722102/3/4/5

Please debit my BARCLAYCARD/ACCESS* account number:

*Please delete whichever does not apply.

Signature

Date

Please rush me:

	Quantity	Price	Total
64K RAM, Assembled		£68.69	
Stock Control Programme		£ 25.00	
Payroll Programme		£ 25.00	

NAME

ADDRESS

VAT @ 15%

Postage £2.00

YC1 TOTAL

To: Memotech Ltd., 3 Collins Street, Oxford, OX4 1XL Telephone (0865) 722102

April 23-25, 1982
Earls Court, London

Friday & Saturday: 10am – 6pm
Sunday: 10am – 5pm

Admission £2.00 adults
£1.00 children under 16.

THE Computer Fair

Personal computers
Home computing
Small business systems

The computer is with us and soon to be as familiar in the home as your television, video or hi-fi. But much more versatile!

A home computer can be the family's resident teacher, accountant, home economics expert, memory bank and endless source of amusement! It can do anything you programme it to do – from teaching mathematics to the children or computing the most economic use of household fuels for yourself, as well as providing hours of fun on a rainy afternoon. Most important of all, the home computer will teach you and your family about computers – and this is the technology that your children are growing up with.

In the office, the personal computer is rapidly replacing the obsolete mound of box files, adding machines and notebooks on thousands of desk tops. Microchip streamlining means increased efficiency in hundreds of different fields.

Sponsored by:
Practical Computing and
Your Computer

adult

THE Computer Fair
Personal computers
Home computing
Small business systems

Cut this coupon and exchange for half-price ticket at the door.

HALF PRICE ADMISSION VOUCHERS

Bringing computers to everyday life

At The Computer Fair you can see and compare an enormous range of personal and home computers. Find out what they can do and which one would suit you best. Talk to the experts and discover for yourself how much – or how little – you need to spend. Choose from an amazing abundance of software programs and packages, cassette units, VDU terminals and scores of computer games.

Swap your views and know-how with hundreds of other home computer enthusiasts – and find out a whole lot more from computer professionals.

Plus – The Micro Mouse Contest.

Come and watch the incredible ingenuity of computer controlled "mice" and how they find their way (or not!) to the centre of a maze. The knockout heats and the Euromicro British Final can all be seen at The Computer Fair!

Bring the whole family – don't miss this opportunity of bringing computers into your everyday life.

IT INFORMATION TECHNOLOGY 82

for readers of YOUR COMPUTER

child

THE Computer Fair
Personal computers
Home computing
Small business systems

Cut this coupon and exchange for half-price ticket at the door.

PROJECT

FIRST-CHOICE FORTH

John Dawson turns his attention to Microtanic's implementation of Forth and finds that it has all the qualities required for writing process-control software.

FORTH IS compact, versatile and extensible. By using reverse-Polish notation and a stack for holding numbers in the correct order for processing, it is possible to achieve remarkable results using only a few kilobytes of RAM.

It is a high-level language with immediate access to an assembler for sections of a program that are time-critical. In the way it makes you approach problems, it could even be called a software-design "philosophy".

Forth begins with a set of words or commands and then provides the mechanism by which you can define your own words, adding these to the commands already in the language to increase the size of the dictionary. The process of building a definition from a number of previously-defined commands is programming in Forth.

For example, a word-processing program would consist at the top of a single command

```
WORDPROCESSOR
```

This is a definition consisting of other definitions such as Print, Write, Store and Append. Each of the definitions within write consists of lower level commands such as:

```
: SPACE LINECOUNT @ IF SPACE
    1 LINECOUNT +! THEN ;
```

which looks at the position identified by Linecount and adds one to Linecount if the character is a space. Eventually, at the lowest level, definitions are composed of sections of machine code. Space is an example of a colon definition, which tells Forth to remember Space and execute the commands within the definition when it is called.

Some words can be used directly by typing the name at the keyboard — Con, for example, in Listing 1. Others may only be used in the course of defining a word, e.g., Do-Loop or Begin-While-Repeat.

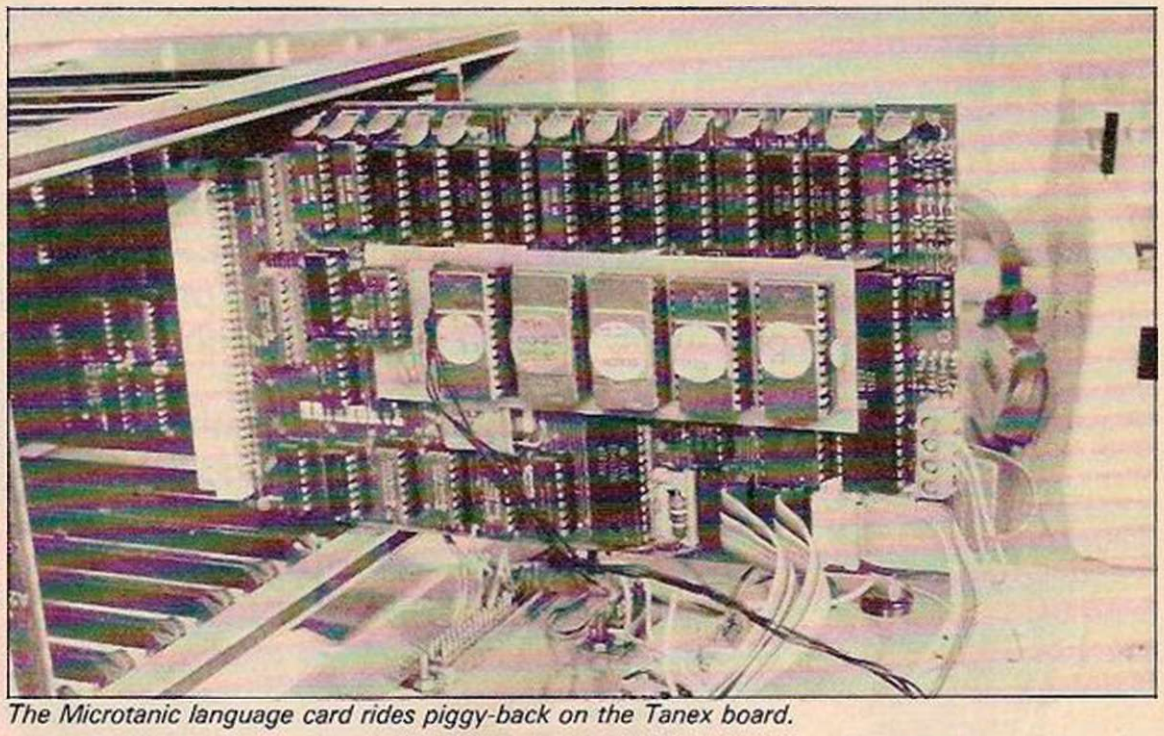
The Forth implementation by Microtanic Software is available either on cassette or in two EPROM chips and is supplied with about 60 pages of documentation. It is the documentation that is the critical part of any package and this Forth system is no exception.

Listing 1.

```
: CON 32-5*9/ . ; OK

99 CON 37 OK

-10 CON -23 OK
-40 CON -40 OK
212 CON 100 OK
```



The Microtanic language card rides piggy-back on the Tanex board.

It is often said that software sells hardware; equally, it is often the documentation that sells the software. It is vital that the examples in instruction manuals — and there should be many examples — should be absolutely correct. The best examples are those printed by the computer where error in transcription is reduced to a minimum.

Microtanic manual

The manual with the Microtanic Forth says: "One of the problems in providing this package at a reasonable price was the extent of documentation that could be provided. A full set of manuals from the Forth Interest Group (FIG) costs in the region of $68".

Nevertheless, the manual could have included more example programs to illustrate the elementary use of the language. The instructions about fixing words you have defined permanently into the dictionary of the tape version are incorrect because the text reads

```
+ ORIGIN
```

in three places rather than

```
+ORIGIN
```

This tiny error stops the instruction working and would not have occurred in a computer printout.

The manual describes the implementation of Forth for the Tangerine Microtan and contains details of the comprehensive editor for writing source programs and a commented list of the words included in the Forth dictionary. Also in the package is a very useful Forth program to print the definitions of all the words in the dictionary.

Two trivial examples of Forth programming are shown here. Listing 1 is a definition of a word that will convert Fahrenheit temperatures to Centigrade. Listing 2 builds definitions into two words that will print the letter F or the number 8. Notice how the low-level command Star simply prints the ASCII character 42 * and how this is progressively incorporated into other words.

The Microtanic Forth appears to be written to the Forth 79 standard — although this is not stated explicitly in the manual — and some of the optional double-precision mathematics commands need to be constructed by the user if these are important for a particular application.

The Forth 79 standard does not include floating-point mathematics. The case is made effectively in *Starting Forth* by Leo Brodie that floating-point is often not necessary if you analyse a problem. Further, the results of a calculation can be scaled by Forth and presented to eight or more significant figures for the final answer without incurring the speed penalties associated with floating-point mathematics performed in software.

This is really the end of my special-purpose interpreter Cogent because Forth will assume its place and perform better many of the tasks I had in mind. Software is hard enough to write without trying to duplicate someone else's work unnecessarily.

It should be possible to define words in Forth to handle interrupts in the Microtan computer, and at the higher levels Forth has all the elegant clarity and ease of expression I was looking for.

FOR CONTROL

Nevertheless, the work on Cogent has been valuable if it showed you that writing a language for a defined area of computing need not be difficult and can produce useful results in applications where you want to be able to arrange a series of high-level instructions to carry out a particular set of tasks.

Although I have not touched on it in the series, you might decide, for example, to write a fast special-purpose interpreter using single-letter high-level commands for handling nothing but machine-code graphics routines for animating games programs. You should also have discovered that there are many more ways of in- and outputting information than by using a simple keyboard and VDU.

The EPROM version of Forth will coexist with Basic in the language board from Microtanic. The single-sided printed-circuit board shown in the photograph measures about 4in. by 2.5in. and has sockets for five 4K EPROMS. It allows you to switch, manually or by software commands, between Forth, Microtanic two-pass assembler, or Basic. It can be used either by plugging it directly into the J2 socket on the Tanex board and allowing it to ride the board piggy-back fashion, or by bringing a 24-way cable with DIL connectors at either end from the Tanex board to the language board. The language board would then be mounted in another part of the computer system.

Intra-system bus

Microtanic Software does not give definite information about the maximum length of cable which can be used before you can expect problems from reflections up and down what is essentially an intra-system bus and piggy-back boards are never mechanically desirable although the one in my system has worked consistently and without fault from the moment of its installation.

One problem is that the language board increases the width of the Tanex to the extent that it is impossible to plug another card into the first expansion slot on the motherboard. My motherboard had four connectors rather than the full 12, and it seems that sockets for the back plane are now as scarce as buffers and memory chips were a year ago.

However, your problems do not end when you have found the socket, for you can expect problems with the paging logic. The instructions issued by Tangerine Computer did not work with the motherboard in my system. In the end I cut the board-select line which stayed stubbornly at +4V and wired the select line permanently low to ground.

The Tangerine documentation has slipped in the past few months and although the manual for the new Tanbug is available, I have not seen a copy. I hope Tangerine will be able to regain the position it had of excellent support for a good computer.

Overall, Forth is a fascinating, sophisticated, easy-to-use software tool with a multitude of possible applications. If you are prepared to invest in a book such as *Starting Forth* or to write to a Forth interest group, I think you can acquire a significant addition to your system which will allow you a new flexibility in programming. In particular, I think Forth should be a good way of approaching subjects closely related to the theme underlying this series of articles.

1982 is Information Technology Year and one of the purposes of the Health Section of the IT82 Committee is to encourage volume production and marketing of microelectronic aids for the disabled and to reduce prices to a level where disabled people will be prepared to buy the devices or tools.

Many disabled people cannot type because they have insufficient strength in their hands. Alternative Input devices have been developed, for example a suck/blow switch can be connected to a single-bit input on the computer and that single binary input can be used to control a word processor or a computer system which will control the heating, lighting, telephone and other electrical equipment in a disabled person's home.

Forth is an ideal language in which to write routines to take information from special-purpose switches — perhaps by bouncing infra-red light off the operator's eye to pick up eye movements and blinks — to control both physical devices and the operation of ordinary commercial software in a microcomputer.

If you start thinking about designing a switch or device for use by somebody who is less able than an ordinary person, a number of factors emerge which you will have to take into account. A switch should give some feedback to the user to indicate that the switching action has taken place.

For example, some keyboards require an increasing pressure on the key until the switch has occurred and then there is a sudden give to let you know that this has happened. Other keyboards provide an audible feedback by bleeping when a key has been pressed.

It is important that operating a key repeatedly should not make the operator tired and should not cause cramp if a person is using one finger or a toe or even a stick attached to their forehead to operate the keys. Remember that this is even more important to the disabled because they are less able than an ordinary person to switch tasks to another part of their body. You can open a door with your foot if your arms are full.

Consistent response

Above all, the machine must be consistent in its response for there is nothing more frustrating to someone who is absolutely dependent on a machine than to have an inconsistent and arbitrary response. Good tools are always predictable in their actions and it is this quality that allows fine control by craftsmen and skilled workers.

You cannot iron clothes with the flat of your hand — you need a tool to do the job. In the same way, a disabled person may require a special telephone or a word processor to communicate. These aids should be available at ordinary retail outlets where you might buy an electric iron.

The combination of Forth, given some additional words in the dictionary for real-time control, with some inventive thinking and clever production engineering could generate a set of tools for the disabled. For the first time, it would be possible to build machines which could be extended and adapted by a person to perform a specific job or task.

Comparatively low-cost machines could be sold for disabled people with the capacity to carry out a wide range of jobs. The user could mould the functions of the machine to suit their own purposes. ■

Listing 2.

```
: STAR 42 EMIT ; OK
: STARS 0 DO STAR LOOP ; OK
: MARGIN CR 20 SPACES ; OK
: BLIP MARGIN STAR ; OK
: BAR MARGIN 5 STARS ; OK
: F BAR BLIP BAR BLIP BLIP CR ; OK
: BLIPS MARGIN STAR 3 SPACES STAR ; OK
: EIGHT BAR BLIPS BLIPS BAR BLIPS BLIPS BAR CR ; OK
```

```
EIGHT
*****
*   *
*   *
*****
*   *
*   *
*****
OK
```

```
F
*****
*
*****
*
*
OK
```

CONTROL TECHNOLOGY
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 16/3** 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**
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**	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

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.

ZX-81

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

All prices include VAT and postage and packing

CONTROL TECHNOLOGY

39 GLOUCESTER ROAD, GEE CROSS, HYDE, CHESHIRE, SK14 5JG
061-368 7558

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".

RANDOM NUMBERS

■ **In the October 1981 issue, you gave what looked like a simple routine to generate random numbers on a PC-1211. However, I could not make head nor tail of the listing. As the routine in the manual is fairly long and complex, I was wondering if you could explain the original listing.**

C Queriera,
Taunton, Somerset.

UNFORTUNATELY, a few gremlins crept into the original listing. Here is a version of it — set up to generate numbers in the range one to six, like a die. This routine, by the way, will work on any computer fitted with floating-point arithmetic. Some computers will need the initial value of X to be entered. The best way to do this is to add a line

```
15 PRINT "MINUTES PAST THE
   HOUR?":INPUT X
```

```
10: REM GENERATE
20: REM RANDOM NUMBERS
30: X=(X+π)^5
40: X=X-INT (X)
50: D=INT (X*6)+1
60: PAUSE D:BEEP 1
70: GOTO 30
```

LOADING ZX-81

■ **I have just bought a ZX-81 1K and have trouble in loading programs from my cassette player. I have tried two other cassette players which do not work either. Could you tell me which model or models could be used?**

Keith Rowe,
Sunderland, Tyne and Wear.

THE ANSWER to the letter from Nicholas Heward should be of use to you.

■ **I have been having a good deal of trouble with my ZX-81 loading system. It will not load software with Print after the line number, as used in a program with graphics in it. Why does the ZX-81 not load programs with a Print in every line? I was also wondering how long the ZX-81 can be kept in continuous operation.**

Nicholas Heward,
Harrogate, North Yorkshire.

THERE SEEMS to be no reason at all why the computer should not Save a program with Prints in every line, and having saved it, allow it to be loaded back. Try the following program. If this does not work, it appears that something is wrong with your ZX-81.

```
10 PRINT
20 PRINT
30 PRINT "TEST"
40 PRINT
50 PRINT "THIS IS A TEST"
60 PRINT
```

This routine worked perfectly on our machine. You do not mention if other programs cause problems. If they do, make sure you are using computer-quality cassettes, rather than ordinary audio ones. Clean the heads before loading and saving each time, and make sure the leads for the computer and cassette connections do not cross over the lead from the power supply. Write a short program and save it. Then practise loading again and again — adjusting your cassette volume a little each time — until you achieve a perfect load. Mark the volume with a little paper arrow, and make sure you always set it at this point when loading. If you buy commercial software, make a copy of your own once you have made it load. You will find this may be easier to load subsequently than the original. Of course, it would be illegal to pass such a copy to a third party. As to your second question, ZX-81s vary from machine to machine. Some appear to lock up — in that they stop reading the keyboard — after a few hours, others will run all day. The likelihood of memory crashes, if extension memory is being used, appears to increase as the machine grows hotter, but again, it varies from computer to computer. Printout, from a printer owned by Mark Harrison, author of *Byteing deeper into your ZX-81,* shows that after about 20 minutes the printer output becomes almost unreadable. This seems to be a fault of the printer.

ZX-81 ANALYSIS

■ **Can you suggest a program for my ZX-81 with 16K RAM to analyse figures? I wish to enter approximately six columns of figures under separate headings, to be totalled at the end. The figures are to be entered in random order. I hope you can help, as I have found your magazine the only one to explain Basic programming easily enough for us simpletons.**

Bernard Kay,
Prestwich, Manchester.

WE HOPE we have understood your requirements. The following program should fill your needs. When you run it, the ZX-81 will ask

HOW MANY CATEGORIES?

If you want six different totals to be maintained, enter 6 at this point. The computer will then ask you to enter, one by one, the names by which you want each category to be known. It will say:

ENTER NAME OF CATEGORY 1

Here, for example, you enter "Nails".

ENTER NAME OF CATEGORY 2

Enter, say, "Screws". Once you have used all your categories, the screen will clear, and the number of each category, the name you have assigned to it, and the total to date will be shown, as:

1 NAILS 0 2 SCREWS 0

The computer will then ask

NUMBER OF CATEGORY

If you wish to update the Screws' total, enter 2. The word "Screws" will appear, and you enter, say, 36. The screen will clear again, and this time will print

1 NAILS 0 2 SCREWS 36

This routine will run on computers other than the ZX-81, but the means by which the names are assigned to the strings depends on the specific string handling of your computer and may well need modification.

```
10 REM "BERNARD KAY
   PROGRAM"
20 REM BY TIM HARTNELL
30 PRINT "HOW MANY
   CATEGORIES?"
40 INPUT A
50 DIM A$(A,10)
60 DIM Z(A)
80 FOR C=1 TO A
90 PRINT "ENTER NAME OF
   CATEGORY NO."; C
100 INPUT A$(C)
110 PRINT A$(C)
120 NEXT C
130 CLS
140 FOR C=1 TO A
150 PRINT C; " ";A$(C);" ";Z(C)
160 NEXT C
170 PRINT
180 PRINT "NUMBER OF
   CATEGORY?"
190 PRINT ,"-99 TO END"
200 INPUT D
210 IF D=-99 THEN STOP
220 PRINT A$(D),"VALUE?"
230 INPUT E
240 LET Z(D)=Z(D)+E
250 GOTO 130
```

BBC PROGRAMS

■ **I am seriously considering buying the new BBC Microcomputer but there are a few points I would like your opinion on: I understand that the BBC machine is an upgraded version of the Acorn Atom, and I would like to know — as there are a large number of programs on the market for the Acorn Atom — if these would run on the BBC Microcomputer. Will the Acorn Atom users' club have a section for the BBC Micro and will the books on the Acorn Atom apply to the BBC machine? I know that certain Acorn Atoms need the floating-point ROM for some programs to run. Does the BBC Micro have floating-point; if not, can it be fitted? Will *Your Computer* be running features on the BBC Micro or will it be covered by articles on the Acorn Atom?**

Glynn Mitchell,
Sheffield.

THE BBC Microcomputer is a new computer developed from the Acorn Atom, rather than an upgraded Atom. It uses a new, more flexible, and in our opinion, much better implementation of Microsoft Basic. The majority of Atom programs will not run as they are, but can easily be modified to run on the BBC machine. Despite this, Sigma Technical Press has published a book by David Johnson-Davies, who created much of the Atom and the BBC Micro, entitled *Practical programs for the BBC Microcomputer and the Acorn Atom,* which suggests they may be reasonably compatible. The Independent Acorn Atom Users' Group, 44-46 Earls Court Road, London W8 6EJ, is incorporating BBC material in its monthly newsletter. The BBC machine has floating-point arithmetic as standard, so no additional ROM is need to provide this. As you will have seen in the February issue, we will certainly be providing articles for owners of BBC machines.

REVERSE VIDEO

■ **In your January 1982 issue of the magazine, page 61, I read the article on "Keyboard changes" by D Butler, and also read there was a modification on the printed-circuit board to reverse the video display on the ZX-81. If so, would you please let me know what it is?**

Raymond Krug,
Felixstowe, Suffolk.

UNFORTUNATELY, there is no simple way to reverse the video on a ZX-81, whereas it is very easy on the ZX-80.

WORD PROCESSOR

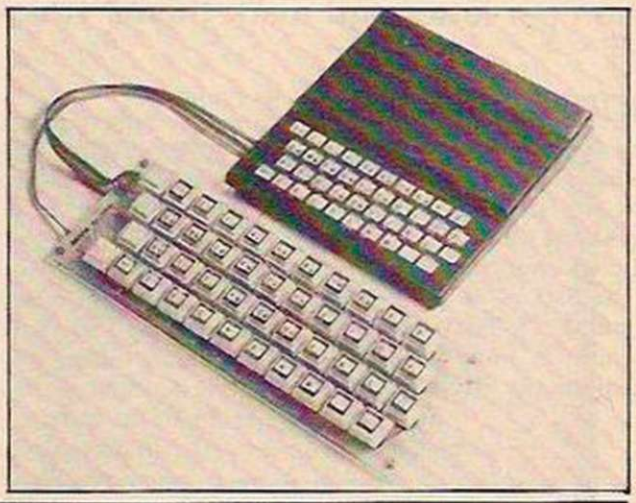
■ **The system I am seeking must be capable of word processing and produce hard copy to the same standard as commercial word processors. I am aware of the fully expanded Atari 800 system, but do not know how this compares to other systems.**

K Weston-Lewis,
Wood Green, London.

YOU DO NOT say, besides word processing, what you wish to use your computer for, and these other uses may well dictate the system you buy. The quality of the output depends, to a large extent, on how much you are prepared to spend on the printer you couple to your computer. A relatively low-cost system could be created from an Acorn Atom using the word processor ROM, and attaching a printer. A cheap one to print on aluminium paper is available, but the results are probably not as good as you may require. An Atom, with word processor ROM, driving a Centronics 737 dot-matrix printer, is perfectly satisfactory, but not, of course, as good as the output from a daisywheel printer. Good word-processing packages are available for a number of computers, including the Pet and Apple series. Overall, though, the quality of output depends on how much you pay, and the machine you buy will depend on the other functions you need it to provide. ■

ZX 80/81 HARDWARE/SOFTWARE

ZX KEYBOARD



A full size keyboard for the 80/81. The keyboard has all the 80/81 functions on the keys, and will greatly increase your programming speed. It is fitted with push type keys as in larger computers.
The keyboard has been specially designed for the Sinclair computer and is supplied ready-built. It also has facilities for 4 extra buttons which could be used for on/off switch, reset, etc. **£27.95**

4K GRAPHICS 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 there 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. IT NEEDS NO EXTRA POWER AND WORKS FROM YOUR NORMAL POWER SUPPLY. **£29.95**

RAM 80/81

16K RAM
Massive add-on memory for 80/81.
16K KIT-A-KIT VERSION
of a 16K Ram. Full instructions included. All memory expansions plug into the user port at the rear of the computer. 16K RAM **£42.95** 16K KIT **£32.95**
2K & 4K RAM
Static Ram memory expansion for the 80/81. They both work with onboard Ram i.e. 4K plus onboard = 5K. This is the cheapest small memory expansion available anywhere. 2K RAM **£15.95.** 4K RAM **£22.95**

16K 81 SOFTWARE

As seen at the ZX Microfair.
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 p&p for all hardware, Software p&p free. Specify ZX80/81 on order.
ALL OUR PRODUCTS ARE COVERED BY A MONEY BACK GUARANTEE

dK'tronics

23 Sussex Road, Gorleston,
Great Yarmouth, Norfolk.
Telephone: Yarmouth (0493) 602453

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.

I RECENTLY RECEIVED a very well-packaged parcel from Tempus of Cambridge. After ripping through what seemed like a large forest's worth of cardboard and newspaper I was all ready to declare it a hoax when I discovered a small box containing Casio's new Mini Electro printer.

The nicely-contoured black plastic FP-10 printer is compatible with the FX-600/700 series. It prints characters in a five-by-seven dot matrix by an electric discharge from seven small electrodes on to a fairly narrow 35mm. roll of metallised paper. Hence the printer is a good 3W source of electromagnetic radiation, sufficient to cause interference to radio communications — according to the instruction manual — and a bright little display of pyrotechnics if you dim the lights. DC power for up to 7,000 lines of printing may be supplied by four AA-size batteries, although a rechargeable battery pack or AC adaptor may be bought separately.

I have not used the adaptor yet: the warning on page three of the manual blandly states that "When using an AC adaptor erroneous printing may occur", which sounds a trifle ominous. The printer will reel off two lines a second at up to 20 characters per line. Quite an improvement on Caxton.

I only used the printer in conjunction with a 602-P but received the impression from the manual that the 702-P facilitates slightly easier and less roundabout usage of the FP-10. The command for printing a displayed line or program result on my machine is a laborious

INV SAVE , INV EXE.

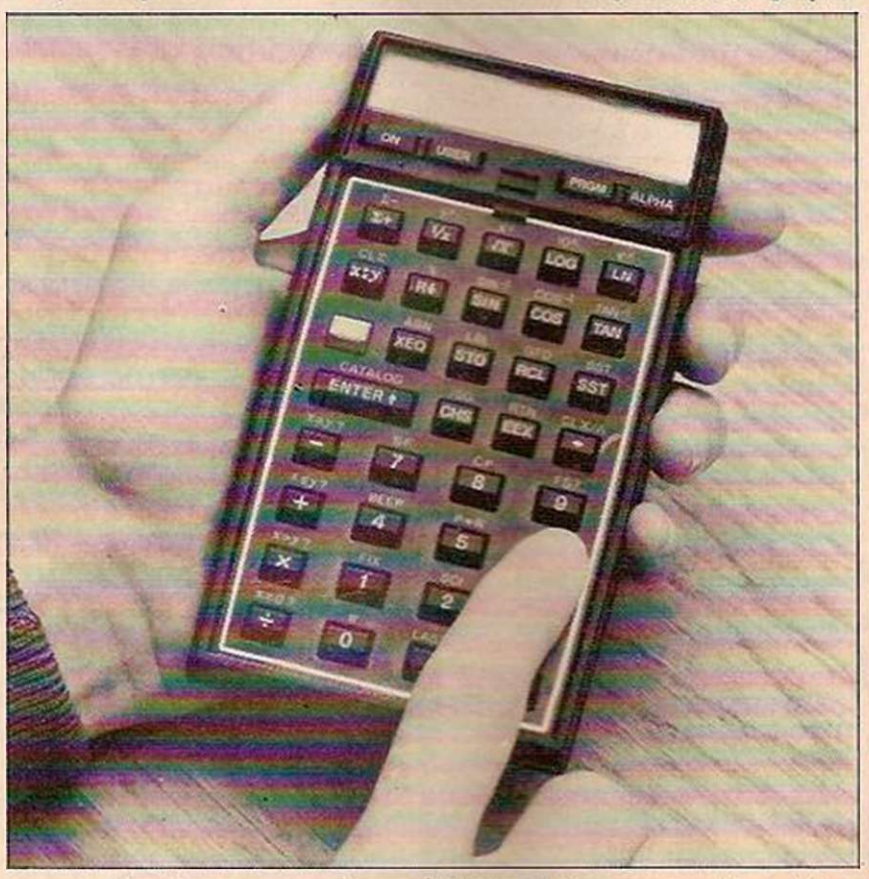
Hence, to print out a variable A which has just been calculated in a program I would have to write

INV ALPHA , A , = , INV ≠ ,
INV ALPHA , INV SAVE , INV EXE.

I found it handy to assign the last four keystrokes to program memory. The 702-P has a more easily remembered and logical PRT command.

Other options available for both calculators are selective or full printing of program listings and all of the memory values. The listing on the 600s has to be performed in PCL mode. This can be annoying, especially as there is quite a rigmarole to eke out a program which has a password. What if you make a mistake in your keying-in and press the AC button instead of the C? Not only is your program not printed but it disappears from the face of the Earth. Music-lovers have the extra bonus of being able to obtain a printing of one of their scores.

So, what is the verdict? The FP-10 is a handy, compact device which gives a high-quality printout, though it does have a mind of its own in deciding how to lay out its listings, which can be disconcerting. For some reason, displayed data starts printing five characters from the right and displayed text, as expected, from the first space on the left. At over half the price of the 602-P it is hardly cheap. I look forward to someone dreaming up some fancy graphics.



In January's *Your Computer* I refreshed your memory on the fundamental unit of any programmable calculator — the byte. Remember that in the HP-41C the same bytes are used for totally different purposes in program, data and alpha-numeric memory. The machine's interpreter only allows certain byte combinations to enter into program memory — if you confuse it you can create "synthetic" lines, some of which are very handy indeed. The most basic way to anaesthetise the interpreter is with the byte jumper, an assigned key command which jumps into the middle of alpha-numeric character strings.

- Perform a Master Clear.
- Insert a memory module and execute SIZE 000.
- Key in ASN "X " shift +, and ASN "Σ +" Σ +.
- Switch the machine off and remove the memory module. Wait at least one minute before replacing.
- Turn the calculator back on and switch to Program mode. You should see 00 REG 126. Press SST once and after a few seconds the display appears as 01ᵀ.

This rigmarole has actually caused the machine to lose its permanent .END. which separates programs from the rest of memory. It used to live inside the memory module until you starved it of its lifeblood — charge.

January's memory layout table makes it quite clear where you are. The SST command has taken you to the first non-zero byte below the Data memory partition — the first assignment register. The display 01ᵀ represents the zero character-string byte, actually stored as F0 in hex, which is present to indicate a register containing assignment information.

SST up to line 06 and you will see all of the assignment coding bytes interpreted as program lines. Altering these lines now amounts to assignment editing.

To do just that, return to line three, press the correction key twice and insert the text line 02ᵀ A. Now perform a GTO . . . and after a very swift PACKING has appeared on the display, SST once and delete the line 01 LBL 01. Return to Normal mode.

You have just entered a user-definable command called the byte jumper. It was made possible by the editing performed on the assignment registers which carry all of the information on the user-definable keys. Of all of the possible combinations of non-normal assignment bytes, this is one of the few which actually performs something. Change to User mode and press the Σ + key. You will see the display

XROM 05,01.

This is the interpreter's name for your assignment, which may be accessed by the Σ + key.

The XROM part of the display signifies that the function is not listed internally by catalogue three. You have actually assigned a two-byte function, the 05,01 part being derived from the last nybble of the first byte and all of the second byte. As the range of such XROM commands is 1½ bytes, the HP-41 is capable of executing 2^{12} or 4096 non-standard functions.

So what does the byte jumper actually do? It permits the line marker in program memory to jump a determined number of bytes into the middle of an alpha-numeric string. The bytes that are jumped over are, as is usual when an alpha-numeric string is encountered, transferred into the alpha-numeric register. The remaining bytes are then interpreted as stand-alone functions.

For instance, key in the following lines. The numbers to the right of the line are the numbers in hexadecimal, which are stored in the memory bytes

01 STO 01 31
02ᵀ BJ F2 42 4A

If you now "byte jump" — by going out of program mode and pressing the Σ + key — from line two, the first byte of the line is transferred into the alpha register and so the next two, having lost the character-string marker, are interpreted as normal program bytes.

It is important to note that at this stage the program has just been misinterpreted and that the original bytes remain as they were in memory. But if, after byte jumping, when the program marker lies between bytes 42 and 4A, you enter new program lines, then you will permanently split up the BJ text line.

The number of bytes which are transferred to the alpha register is purely determined by the value of the last nybble of the line preceding the program marker. Thus, if the first line had been STO 03 — value 33 in hex — then all of the bytes would have been transferred.

Now that you have the basis of creating non-normal lines at your fingertips you can get on with discovering many of the untold mysteries of the HP-41C. If you find any useful or amusing byte combinations then do write in to *Your Computer* and let us know.

For further useful information you can write for details of synthetic programming to Larken Publications, 4517 NW Queen's Avenue, Corvallis, Oregon, 97330, U.S.A.

Note that the byte-jumping routine will not directly work on the HP-41CV. A specially-written bar code, available from Larken, will do the job.

END statement and program labels both form part of what is called the global chain of program memory. The calculator maintains a linked list in RAM of all their absolute addresses.

Three nybbles are needed to define an address: three bits for the byte within the register and nine bits for the register. So when the calculator attempts to find out what the previous instruction in RAM is, it jumps back up the global chain until

(continued on next page)

```
                          0 STO-0 CLEARS SCORE REGISTER
FIRST DIGIT OF GUESS        STO-1
SECOND DIGIT OF GUESS       STO-2
THIRD DIGIT OF GUESS        STO-3
                              X⇆T PLACES LAST DIGIT OF
                                  GUESS IN THE COMPARISON
                                  REGISTER (MEMORY 7)
                            R/S GO!
```

Listing 1. Keystroke sequence to enter your guess.

(continued from previous page)
it reaches a global with an absolute address which is higher than the current address-counter contents. This may not be the top of the current file, and you can make use of this while editing a lengthy program by inserting a label, e.g., Edit, at the place where the lowest-numbered line will be edited. This considerably speeds up the backward jumping and, once you have finished, the label can easily be found for deletion.

An END needs a full three bytes of memory: three nybbles are required for the address, and one more nybble is needed to let the interpreter know that it is a global instruction. The third byte is used to provide information on the current program, i.e., whether it has been packed and whether it is the last program in memory.

Frank Wales, my Scottish calculator guru, assures me that there is an intermediate state in which the calculator may be found. This occurs when you have just edited a program, but have not packed it. The last nybble of the END is then different to that for a usual packed or unpacked program.

The calculator uses this as a sign that rapid branch jumps — stores in GTOs and XEQs — may be incorrect and these must be updated. Such updating occurs when you switch out of Program mode and this is why there may be a delay when you press the PRGM key.

One problem which Hewlett Packard has discovered with this is that you can switch the calculator off without getting out of Program mode. On switching the calculator back to Normal mode it will not have recompiled the addresses. So to be on the safe side, toggle the PRGM switch on and off after an editing session.

In an attempt to while away several hours on a snowbound train, Roger Davis of Woking has written a Mastermind program for the TI-57 Programmable. The calculator generates a three-digit number which the player must deduce.

- Steps 00 to 05 store an "unknown" number of three digits in memories 4, 5 and 6.
- Steps 06 to 08 display score and relocate program for next guess.
- Steps 09 to 19 arrange memories for comparison.
- Steps 20 to 29 are a subroutine for generating "random" digits for the "unknown" number.
- Steps 30 to 42 are a comparison subroutine.
- Steps 43 to 45 are a subroutine for scoring correct digit in correct place.
- Steps 46 to 49 are a subroutine for scoring correct digit in wrong place.

The game is played as follows:

- Enter program and reset.
- Enter a decimal fraction of any length into the display, e.g., .42775.
- Press STO-7 then R/S. When the sequence is finished, the contents of memory 0 — the score register — are displayed.
- Enter the first guess at the three-digit number using the keystroke sequence in listing 1. The calculator will now compare each digit of the guess with each digit of the unknown number. The program returns to the correct place for entering the next guess, and displays the score for the last guess. It will score the digit itself for each correct digit in the correct place, and 1 for each correct digit in the wrong place. For example, if the unknown number is 539:

  953 will score 3,
  735 will score 4,
  579 will score 14,
  539 will score 17.

  Because every digit of the guess is compared with every digit of the "unknown", apparently anomalous scores are obtained when the same digit is repeated in the guess. In the above example, a guess of 555 will score 7, not 5.
- Repeat the "guess" sequence for subsequent guesses. The unknown digits may be retrieved by recalling memories 4, 5 and 6 in that order.
- To play again, reset and start from stage (2) above.

It helps considerably to have a pencil and paper handy.

Finally, we have some observations on the Casio Scientific FX-81 from Christopher Gill of High Wycombe, Buckinghamshire. The FX-81 is based on the discontinued FX-80 calculator, the most important difference between the two being that the FX-80 College has a standard-deviation function. The mode-selection key DRG, when pressed after the INV key, causes the sign SD to appear in the bottom, right-hand corner of the read-out. Then data can be entered using the memory plus M+ key. Using the third row of function keys — keys 1/k, X ↔Y, etc. — you can display the functions Σx^2, Σx, n, $\bar{x}$, σn, and $\sigma n-1$, for any number of values of the variable x.

The FX-81 does not have this feature on its keyboard. Press INV followed by DRG and the error sign appears in the bottom, right-hand corner of the readout. If you ignore the error sign, and enter data using M+ as in the case of the FX-80, you will find that it works exactly like the FX-80. You can obtain the arithmetic mean, population standard deviation, sample standard deviation, number of data (n), sum of x, and sum of x^2, at the touch of one of the keys.

Similarly there are other functions of the FX-80 that are omitted from the keyboard of the FX-81 but which nevertheless work in exactly the same way on the two calculators. The + key can be used after pressing INV and using X ↔Y to convert rectangular to polar co-ordinates.

Given values of x and y, key in x, INV, +, y, =, and the value of r appears. Then key in X →Y, and you get the value of angle θ. The minus key converts from polar to rectangular co-ordinates: key in r, INV, −, θ, =, and the value of x appears. Then key in X ↔Y, and you get the value of y.

The other two functions you need to know are used when calculating standard deviations using INV, DRG. INV followed by AC clears all the data entered, and INV followed by M+ deletes one value of x that has been wrongly entered.

Can anyone explain why Casio should sell a calculator and deliberately hide from the user these extra functions that it possesses? ■

Listing 2. Mastermind for TI-57 Programmable.

STEP	KEYSTROKE	STEP	KEYSTROKE
00	SBR-1	25	EE
01	STO-4	26	1
02	SBR-1	27	2nd INT
03	STO-5	28	INVEE
04	SBR-1	29	INVSBR
05	STO-6		
		30	2nd LBL-2
06	2nd LBL-0	31	2nd X=T
07	RCL-0	32	GTO-3
08	R/S	33	RCL-4
		34	2nd X=T
09	RCL-6	35	GTO-4
10	SBR-2	36	RCL-5
11	RCL-2	37	2nd X=T
12	STO-7	38	GTO-4
13	RCL-5	39	RCL-6
14	SBR-2	40	2nd X=T
15	RCL-1	41	GTO-4
16	STO-7	42	INVSBR
17	RCL-4		
18	SBR-2	43	2nd LBL-3
19	GTO-0	44	SUM-0
		45	INVSBR
20	2nd LBL-1		
21	RCL-7	46	2nd LBL-4
22	2nd INVCOS	47	1
23	2nd INVINT	48	SUM-0
24	STO-7	49	INVSBR

SALE ELECTRONIC GAMES

NOW £40 OFF

ATARI T.V. GAME

THE GAME WITH 50 CARTRIDGES

R.R.P. £129.95 (inc. VAT)

OUR PRICE

£78.22 + VAT

(= £89.95 inc. VAT)

The Atari is supplied with a free mains adaptor, a pair of paddles, a pair of joysticks and a combat cartridge and is the most popular television game on the market and has a range of over 40 different cartridges. In addition to the standard Atari range we also now stock the new Activision cartridges which are currently on special offer reduced from £18.95 to **£16.95 inc. VAT**

ATARI CARTRIDGES

20% OFF R.R.P.

Atari Soccer £29.95
NOW £23.95

Activision Dragster £18.95
NOW £14.95

Activision Boxing £18.95
NOW £14.95

ATARI OWNERS CLUB — Why not join our *FREE* Silica Atari Owners Club and receive our bi-monthly newsletter with special offers and details of the latest new cartridge releases. Telephone us with your name and address and we will add your name to our computer mailing list.

NOW £50 OFF

MATTEL INTELLIVISION

THE ULTIMATE T.V. GAME

R.R.P. £229.95 (inc. VAT)

OUR PRICE

£156.48 + VAT

(£179.95 inc. VAT)

6 NEW CARTRIDGES JUST RELEASED:
ASTROSMASH ★ SNAFU ★ BOWLING
SPACE ARMADA ★ BOXING
TRIPLE ACTION

All 19 current cartridges + the six new ones above now retail at £19.95 — **Silica special offer price £17.95 inc VAT**

The Mattel Intellivision is the most advanced T.V. game in the world with a range of over 25 different cartridges all at our special offer price of £17.95. This game uses a 16-bit microprocessor giving 16 colours and three-part harmony sound. The picture quality is incredible with 3D effects and realistic animation. An add on keyboard will be available in the Spring 1982 to convert the Mattel into a full home computer with 16K RAM which will be fully expandable and programmable in Microsoft Basic. Other accessories will be added later in the year. The normal price of the Intellivision + free soccer cartridge is £229.95 but our special offer price is £179.95 inc. VAT saving you £50.00.

MATTEL OWNERS CLUB — Why not join our Mattel Owners Club and recive our regular newsletters containing details of all the latest cartridge releases. Telephone us with your name and addresses and we will add your name to our computer mailing list.

FREE 16 PAGE CARTRIDGE CATALOGUE — If you are interested in owning a Mattel, we now have available a 16 page catalogue describing the latest six cartridges to be released, as well as a new Mattel colour leaflet with brief descriptions of all 25 cartridges. Telephone us for further details.

T.V. GAME CARTRIDGES

We specialise in the whole range of T.V. games and sell cartridges for the following games:
ATARI ★ MATTEL ★ ACETRONIC ★ PHILIPS ★ DATABASE ★ ROWTRON ★ INTERTON ★ TELENG
Let us know if you own any of these games and we will let you have details of the range of cartridges available.
Attention INTERTON & ACETRONIC owners we have over 75 assorted used cartridges in stock all with 1 year guarantee — *SPECIAL OFFER* £8.95 each

We also have a number of secondhand games and cartridges.

NOW £8 OFF

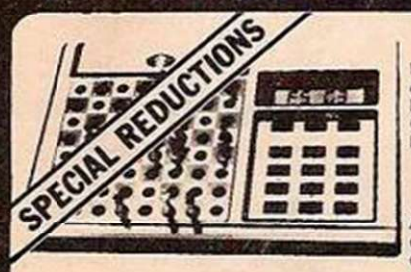
HAND-HELD GAMES

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.

R.R.P. £26.95 **NOW £18.95** inc. VAT

SPECIAL REDUCTIONS



ELECTRONIC CHESS

Liquid crystal battery chess computer with 100-200 hrs battery life and two levels of play. Comes with separate chess board and pieces.

NOW £5 OFF
R.R.P. £24.95
SALE PRICE
£19.95 (inc. VAT)

GRADUATE CHESS

A de luxe version of the electronic chess set with integral chess board. The ideal portable chess set — see illustration.

NOW
£29.95
INC VAT

FIDELITY MINI-SENSORY CHESS COMPUTER

The very first chess computer of its price to offer a portable computer with integral sensory board. Battery (6-8 hrs) or mains operated. This is a modular game and additional plug-in modules are planned for 1982 for advanced chess, popular openings, greatest master games, draughts and reversi.

MINI-SENSORY COMPUTER WITH STANDARD CHESS MODULE WAS £54.50 *NOW* **£49.95** INC VAT

Silica Shop are one of the country's leading specialists in Chess Computers and now stock a range of more than 20 Chess Computers, including Challenger 7/10/voice, Sensory 8 and Sensory Voice, Diplomat, System 3, Morphy, Great Game Machine, Voice Champion, and the new Scicys Mark V.

NOW £10 OFF

PAC MAN 2

Pac Man 2 is based on the latest pub game. It is a two-colour game of strategy, tactical pursuit and destruction pitting Pac Man against the large Ghosts. The object of the game is for Pac Man to attain as high a score as possible by capturing and destroying Ghosts, Bugs and Energizers without being himself destroyed by the Ghosts. Pac Man 2 incorporates the most modern and complex status displays ever produced and is now on release for the first in the UK offering an ideal present.

R.R.P. £34.95 **NOW £24.95** inc. VAT

NOW £8 OFF

SPACE INVADERS

Based on one of the most popular arcade games, Space Invader™ packs in lots of action with multi-shaped, brilliant LED vessels, including attack ships, bombs, defenders, missile rockets and a beam force cannon, plus exciting electronic sound effects. The attack ships attempt to bomb the ground defenders as they are moving. You manoeuvre the missile rockets — avoiding alien bombs — and destroy the invader force as quickly as you can. Progressive degree of difficulty. Includes automatic digital scoring. For ages 6 to adult.

R.R.P. £24.95 **NOW £16.95** inc. VAT

LESS THAN ½ PRICE

COLOUR CARTRIDGE T.V. GAME

Semi Programmable T.V. game
+ 4 cartridges
+ mains transformer
NOW £43.50 OFF
R.R.P. £73
SALE PRICE **£29.50** inc. VAT)

SCOOP PURCHASE NOW ½ PRICE

BACKGAMMON COMPUTER

Silica stock a wide range of Backgammon computers from £28.95 upwards. Special offers now available on Gammonaser.

Was £99.95
NOW **£48.50** inc VAT

CALL JOTTER — THE AFFORDABLE ANSWER

½ THE PRICE OF COMPARABLE MACHINES

The Post Office certified telephone answering machine

"Sorry darling, I will be late home — Love John"

The Call Jotter I brings the affordable answer at the amazing price of £69 (or £99 for the Call Jotter 2 with built-in remote recall facilities). These amazing telephone answering machines are Post Office certified and guaranteed for one year. They make a thoughtful gift for home or business use.

Call Jotter 3 illustrated TWINTAPE £139 *NOW* **£69.00** inc VAT

NOW £75 OFF

ADD-ON ADAPTOR

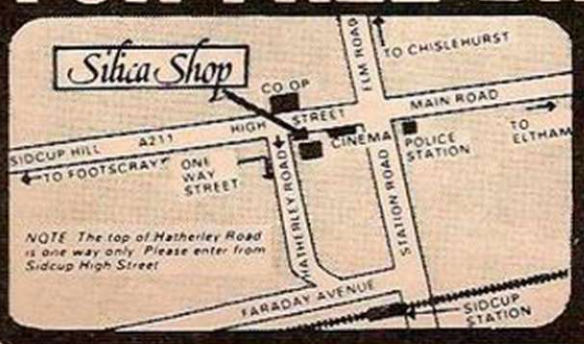
WAS £199 inc. VAT
SALE PRICE £124 inc VAT

RADOFIN TELETEXT

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

THIS NEW MODEL INCORPORATES:
*Double height character display *True PAL Colour *Meets latest BBC & IBA broadcast specifications *Push button channel change *Union master to remove the unit to watch normal TV programmes *Gold plated circuit board for reliability

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 48-hour 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 36 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. YCO 0382
1-4 The Mews, Hatherley Road, Sidcup, Kent DA14 4DX
Telephone: 01-301 1111 or 01-309 1111

SILICA SHOP

THREE PET TITLES from Nick Hampshire

LIBRARY OF PET SUBROUTINES

A book which will save the software designer considerable time by providing 55 proven subroutines to integrate with his own programmes.

Each subroutine is preceded by a page of general information describing its purpose and implementation and possible problems that may arise. Basic, machine language and a combination of both, are used throughout this publication.

". . . We like this book very much and thoroughly recommend it."
Printout

". . . well prepared, fun to use, and will help in better program development."
Compute

All 3 publications are widely used by Commodore Business Machines.

THE PET REVEALED

A reference book which details everything you need to know about the workings of the PET. Containing information helpful to writing more elaborate programmes, which in turn create more interesting functions.

". . . Should be congratulated. Supplies some much needed, useful and correct documentation."
Compute

". . . 'PET Revealed' will save you an awful lot of time. I rate this book as good value for money."
Printout

PET GRAPHICS

This book has two objectives. One, to provide the reader with an introduction to the programming techniques used to generate graphic displays. Two, providing the programmer with a complete package of machine code routines giving a wide range of normally unavailable graphic functions. The book contains many comprehensively analysed routines and photographs to illustrate the effects created.

". . . an invaluable guide to graphics on the PET."
Micro Forecast

Please send me:

..... copy/ies of Library of PET Subroutines @ £10.00 each

..... copy/ies of The PET Revealed @ £10.00 each

..... copy/ies of PET Graphics @ £12.00 each

I enclose a cheque for £ ..... payable to Computabits Ltd.,P.O. Box 13, Yeovil, Somerset.

Name .....

Address .....

.....

.....

..... Postcode .....

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.

Silent running

S A Nicholls,
Keynsham, Bristol.

ZX-81

THIS FLICKER-free game program is written for the ZX-81 in machine code. It is only suitable for machines with from 1K to less than 3.5K RAM, because of the way the background is printed.

The object of the game is to hit a submarine with a depth charge in the shortest time possible. The display occupies the full screen. Movement of your ship is controlled by key 5 for left and 8 for right. The ship has twice the speed of the submarine. A depth charge is dropped by pressing the 0 key.

The display has a counter which starts at 999 and counts down in ones to zero in roughly 25 seconds. The game finishes when the counter reaches zero or when a submarine is hit, at which point the counter will stop at your score. The submarine travels from right to left and its speed decreases continuously as the game progresses to give more time to hit it. The first pass takes approximately one second.

The depth of the submarine also increases with each pass of the screen. When it reaches the sea-bed the next pass will be at the top of the sea and so on. To enter the program which is written for a line-1 Rem statement, the following Basic program can be used:

```
1 REM — followed by 323 zeros — for
  machine-code store
10 LET X = 16514
20 LET A$ = " "
30 IF A$ = " " then input A$
40 IF A$ = "S" then stop
50 POKE X, 16* code A$ + code A$ (2) - 476
60 LET X = X + 1
70 LET A$ = A$ (3 TO)
80 GOTO 30
```

This program will allow you to enter blocks of machine-code at each input prompt. I find it easier to enter one line at a time. For example, 0606 Newline 3E 76 Newline D7 and so on. After the last byte, C9 is entered. Then input S to stop the program.

The Basic program is best entered and Run in Fast mode, as 323 zeros take some time to enter in Slow. After entering the machine-code, delete lines 10 to 80 and insert:

```
10 IF NOT USR 16514 THEN PRINT "MISSED"
```

The program should now be saved so that if mistakes have been made in entering the code, you will not have to start again but just reload and check the listing by Peeking at each address from 16514 to 16839. All that is needed now is to type Run as a direct command and the game can be played.

```
(16514) 06  06        START
            3E  76
        D7
        10  FD
        AF
        D7
        3E  25
        D7
        D7
        D7
        3E  76
        D7
        D7              PRINT
        06  40        BACKGROUND
        3E  0E
        D7
        10  FD
        21  40  01
        3E  88
        D7
        2B
        7C
        B5
        20  F8
        06  20
        3E  80
        D7
        10  FD
        2A  0C  40      INITIALISE
        11  4A  00      SHIP POSITION
        19
        22  3C  40
        21  00  01      SET START SPEED
        22  44  40
        2A  32  40
        23
        22  32  40
        7D
        E6  07
        CE  05
        CD  19  15
        3E  21          INITIALISE
        CD  19  15      SUB POSITION
        EF
        04
        34
        CD  A7  0E
        2A  0C  40
        09
        11  09  00
        19
        22  40  40
        01  00  00    LD BC,0
(16613)-2A  44  40
                  23
        22  44  40
        2A  44  40        INCREASING DELAY
        2B
        7C
        B5
        20  FB
        2A  0C  40
        11  0A  00
        19
        7E
        A7
        20  08
        06  03
        23                DECREASE SCORE
        36  1C
        10  FB
        C9
        3D
        FE  1B
        20  05
        36  25
        2B
        18  EA
        77
        04
        CB  40            MOVE SHIP AT
        20  66            TWICE SPEED
        2A  40  40        OF SUB
        7E
        FE  BB
        CA  B6  41
```

(continued on next page)

(continued from previous page)

```
          36 88
          23
          36 88
          23
          36 88
          2B                MOVE SUB
          2B
          2B
          7E
          FE 76
          28 8D
          22 40 40
          36 8A
          23
          36 B1
          23
          36 8A
          AF
          B9                CHECK FOR DEPTH
          20 13             CHARGE DROPPED
(16703)-3A  26  40
          FE  FD        CHECK 0 KEY
          20  38        PRESSED
          0E  01
          2A  3C  40
          11  22  00    INITIALISE
          19             D/CHARGE
          22  42  40
          2A  42  40    MOVE D/C
          36  88
          11  21  00
          19
          7E            CHECK FOR SEA BED
          FE  80
          20  04
          0E  00
          18  1A
          7E
          FE  B1        CHECK HIT
          28  4D
          2A  40  40
          2B
          7E            CHECK SUB AT
          FE 76         END OF LINE
          28 EE
          2A  42  40
          11  21  00
          19            PRINT D/C
          36  BB        AND STORE NEW POSITION
          22  42  40
          2A  3C  40
          36  0E        MOVE SHIP
          23
          36  0E
          23
          36  0E
          3A  26  40
          FE  DF        CHECK LEFT
          20  0B        KEY 5
          2B
          2B
          2B
          7E
          FE  76
          20  10
          23
          18  0D
          FE  F7        CHECK RIGHT
          20  07        KEY 8
          23
(16800)-7E
          FE  76
          20 01
          2B
          2B
          2B
          22 3C 40        STORE NEW
          36 86           POSITION
          23
          36 BB           REPRINT SHIP
          23
          36 06
          C3 E5 40        JP DELAY
          2A 40 40
          36 A7
          23              HIT SUB
          36 B4
          23
          36 B4
          23
          36 B2
(16836)-C9                RETURN TO BASIC

10 IF NOT USR 16514 THEN PRINT
                          "MISSED"
```

Load warning

G Sleet,
Tuffley, Gloucester.

ATOM

MANY TIMES I have sat staring at my Atom's screen, waiting for it to finish loading my latest program, only to discover that the tape lead is not plugged in. This program gets around this problem by making the Atom's internal loudspeaker buzz and the top, right-hand corner of the screen flash when the Atom is loading from tape.

It is done by redirecting the OSBGET routine to the machine-code routine in the program, line 240. Now the Atom loads each byte from the tape as normal, but then plays it through the internal loudspeaker of the Atom and stores it in location 801F hex on the screen before processing it, lines 35 to 60.

Lines 65 to 210 produce a bleep whenever the OSWRCH routine is called, i.e., whenever a character is printed on the screen OSWRCH is redirected to this routine in line 250. The bleep is produced from lines 130 to 180, using the method described on page 114 of the Atom manual.

The frequency of the bleep depends on the value of the ASCII code of the character printed. The length of the bleep depends on the value of location 83 hex which can be changed as required.

The bleep can be turned on or off by keying CTRL-1 in direct mode or using Print $17 in a program. Both of these routines are stored in the free space of the floating-point RAM from 28C0 hex to 28FF hex and so it should work on any Atom with at least 1K RAM in the lower text space.

Once the program has been run it is no longer needed, so type New and use the Atom as normal. The routines will still remain intact and can be saved on tape by typing:

*SAVE"LOAD/BLEEP"28C0 28FF

The next time you want to load the sub-routines, type:

*LOAD"LOAD/BLEEP"

To start the BGTVEC routine type:

?# 214 = # C0;?# 215 = # 28

To start the WRCVEC routine type:

?# 208 = # CA;?209 = # 28

If you have typed in the hex dump, or pressed the Break key, the two routines must be started up again in the same way.

```
G. SLEET  ATOM LOAD BLEEP

1 DIM VV3
10 PRINT $21
20 FOR I=1 TO 2;P=#28C0
30 [
35\BGTVEC ROUTINE:
40 JSR #FBEE
50 STA #801F;STA #B002
60 RTS
65\WRCVEC ROUTINE:
70 JSR #FE52
80 STA #80;STX #81;STY #82
90 CMP@17;BNE VV0
```

```
100 LDA #84;EOR@#FF;STA #84
110:VV0
120 LDA #84;BPL VV1
130 LDY #83;LDA #B002
140:VV2
150 LDX #80
160:VV3 DEX;BNE VV3
170 EOR@4;STA #B002
180 DEY;BNE VV2
190:VV1
200 LDA #80;LDX #81;LDY #82
210 RTS
220 ⊐
```

```
230 NEXT I;PRINT $6
240 ?#214=#C0;?#215=#28
250 ?#208=#CA;?#209=#28
260 END
    hex dump of load bleep routine:
28C0 20 EE FB 8D 1F 80 8D 02
28C8 B0 60 20 52 FE 85 80 86
28D0 81 84 82 C9 11 D0 06 A5
28D8 84 49 FF 85 84 A5 84 10
28E0 12 A4 83 AD 02 B0 A6 80
28E8 CA D0 FD 49 04 8D 02 B0
28F0 88 D0 F3 A5 80 A6 81 A4
28F8 82 60 00 00 00 00 00 00
```

Molecules

ZX-81

B G Cornhill,
Aylesbury, Buckinghamshire.

THIS IS a 5.7K program for playing the game Molecules on your expanded ZX-81. The computer constructs a molecule from one to seven atoms in size and you have to guess its shape. You do this by shining imaginary rays of light and then trying to calculate the positions of the atoms from the deflection recorded.

A ray of light striking an atom straight on is totally absorbed and produces a black square at point of entry. Reflected rays are turned through 90° when they strike an atom a glancing blow. A ray entered at 28 was turned left at the first atom it encountered, then left twice more causing it to U-turn, then turned again by 90° to exit at the same place it entered.

A ray that glances an atom immediately on entry is reflected straight out and marked by an inverse-video 0. Entering P allows you to plot guesses, or alter any guesses you have made. When you have had enough, enter F. The computer will then display the actual location.

To allow conversion to other machines, here are the program lines and their various CHR$.

Lines 10 to 77 display the instructions on the screen.

Lines 80 to 330 draw the grid with all the numbers intact, and a blank grid.

Line 340 initialises the array used to hold the grid information. It is larger in size than required purely to facilitate the grid search and screen printing. The first figures are for the line ,0 at the top; the second figures are for the columns ,0 on the left.

Lines 350 to 370 ask for the number of atoms — one to seven. Seven seems to be enough, but this can be increased.

Lines 380 to 420 randomly locate the atoms to the array.

Line 430 is the starting point and re-entry point of the rest of the program. It is here you are asked the entry point. You enter your choice of 1-8, 9-16, 17-24, 25-32.

Lines 1330 to 1400 is the routine for entering your guesses or editing your guesses.

Lines 1400 to 1480 is the end routine which displays the shape.

Lines 450 to 510 calculate which side you are entering from and send you to the correct routine.

Line 520 is an error check.

Lines 540 to 620 contain the routine for the light moving down the array and check ahead for either total absorption, deflection or passing straight through.

Line 640 exits if you are deflected to the right.

Line 670 exits if you are deflected to the left.

Lines 671 to 860 contain the routine which checks from left to right.

Lines 870 to 1090 is the routine which checks from bottom to top.

Lines 1100 to 1320 is the routine which checks from right to left.

Each of the direction routines must cater for entry part of the way into the routine and for leaving it before it is finished. Hence, the absence of Gosubs: they could confuse the return statements. For example, entry at 28 used the left-to-right routine, then bottom to top, then right to left, then top to bottom, then right to left leaving at the entry point totally deflected.

The use of the Q numbers is to allow the computer to place the correct graphic symbol at the entry point and exit point. When you have entered the program, line 1490 must be entered initially with the normal S command for the word atoms. When you are ready to record, enter Run 1490 and it will always start automatically on loading.

```
10 PRINT TAB 13;"ATOMS"
20 PRINT
30 PRINT "THE GAME OF ATOMS. FIRST
ENTRY IS TO SET THE NUMBER OF
ATOMS IN THE MOLECULE FROM 1 TO 7."
40 PRINT "CHOOSE YOUR ENTRY POINT.
A ▧  WILL APPEAR AT ENTRY. A ■ FOR
NO EXIT. AND AN ▩  FOR AN EXIT."
50 PRINT "ENTER""P""IF YOU WANT TO
PUT A TEST ATOM ON THE GRID. TO
REMOVE IT PLACE A SPACE."
60 PRINT "WHEN YOU FINALLY DECIDE
TO STICK ENTER""F"""
70 PRINT "PRESS N/L WHEN READY"
75 INPUT A$
77 CLS
80 PRINT AT 2,7;CHR$ 135;AT 2,23;
CHR$ 4;AT 18,7;CHR$ 2;AT 18,23;CHR$ 1
90 LET O=2
100 FOR N=1 TO 8
110 PRINT AT 1,6+O;N
115 LET O=O+2
120 NEXT N
125 LET O=2
140 FOR N=9 TO 16
150 PRINT AT 1+O,24;N
155 LET O=O+2
160 NEXT N
165 LET O=2
170 FOR N=32 TO 25 STEP -1
180 PRINT AT 1+O,5;N
185 LET O=O+2
190 NEXT N
200 PRINT AT 19,8;"2 2 2 2 2 1 1 1"
210 PRINT AT 20,8;"4 3 2 1 0 9 8 7"
220 FOR N=0 TO 14
225 PRINT AT 3+N,7;CHR$ 133
226 PRINT AT 3+N,23;CHR$ 5
230 PRINT AT 2,8+N;CHR$ 131
240 PRINT AT 4,8+N;CHR$ 22
245 PRINT AT 6,8+N;CHR$ 22
250 PRINT AT 8,8+N;CHR$ 22
255 PRINT AT 10,8+N;CHR$ 22
260 PRINT AT 12,8+N;CHR$ 22
265 PRINT AT 14,8+N;CHR$ 22
270 PRINT AT 16,8+N;CHR$ 22
275 PRINT AT 18,8+N;CHR$ 3
276 NEXT N
277 FOR N=0 TO 14 STEP 2
285 PRINT AT 3+N,9;CHR$ 14
290 PRINT AT 3+N,11;CHR$ 14
295 PRINT AT 3+N,13;CHR$ 14
300 PRINT AT 3+N,15;CHR$ 14
310 PRINT AT 3+N,17;CHR$ 14
315 PRINT AT 3+N,19;CHR$ 14
320 PRINT AT 3+N,21;CHR$ 14
330 NEXT N
340 DIM A(11,10)
350 PRINT AT 21,0;"NUMBER OF ATOMS
1 TO 7"
360 INPUT AT
365 RAND
370 IF AT<1 OR AT>7 THEN GOTO 360
380 FOR N=1 TO AT
390 LET B=INT (RND*8)+2
400 LET B1=INT (RND*8)+2
410 LET A(B,B1)=99
420 NEXT N
430 PRINT AT 21,0;"ENTRY NO,P O
R F      "
440 INPUT A$
445 LET D=2
450 IF A$="P" THEN GOTO 1330
460 IF A$="F" THEN GOTO 1410
```

(continued on page 69)

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 £6.50 + 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
TELEPHONE: (0344) 27317

ADVENTURE GAMES

Dungeons, dragons, dwarves and hidden treasure... we look at the history of adventure games and itemise the suppliers.

Ever wondered how you would fare as a programmer? Ask Patsy: a program based on the IBM Programmers Aptitude test which measures your potential.

Cape Kennedy in your own home? A program for the Video Genie and TRS-80 enables you to predict the position of orbiting satellites.

Chuck Peddle thinks again. The man who designed the Pet now presents Sirius – and we review this exciting new micro... THIS IS JUST A SAMPLE OF PRACTICAL COMPUTING TOGETHER WITH ADVICE FOR USERS OF PET, APPLE, TANDY AND SINCLAIR ZX 80/81 COMPUTERS. BUY BRITAIN'S LEADING PERSONAL COMPUTER MAGAZINE. MARCH ISSUE OUT NOW.

80p AT YOUR NEWSAGENT'S – BUT HURRY.

Practical Computing

(continued from page 67)

```
470 LET P=VAL A$
480 IF P*(P>0 AND P(9)>0 THEN GOTO 540
490 IF P*(P>8 AND P(17)>0 THEN GOTO 1100
500 IF P*(P>16 AND P(25)>0 THEN GOTO 870
510 IF P*(P>24 AND P(33)>0 THEN GOTO 671
520 PRINT AT 21,0;"WRONG
530 GOTO 440
535 REM DOWN
540 LET P=P+1
550 PRINT AT 1,5+(P*2-1);CHR$ 136
555 LET Q1=1
556 LET Q2=5+(P*2-1)
560 IF A(D,P)=99 THEN PRINT AT
Q1,Q2;CHR$ 128
565 IF A (D,P)=99 THEN GOTO 430
570 IF A(D,P-1)=99 THEN GOTO 620
580 IF A(D,P+1)=99 THEN GOTO 650
590 LET D=D+1
600 IF D>9 THEN PRINT AT 19,5+(
610 IF D>9 THEN GOTO 430
615 GOTO 560
620 IF D<=2 THEN PRINT AT 1,5+(P*2-1); CHR$ 180
630 IF D<=2 THEN GOTO 430
635 LET D=D-1
640 GOTO 770
650 IF D<=2 THEN PRINT AT 1,5+(P*2-1); CHR$ 180
660 IF D<=2 THEN GOTO 430
665 LET D=D-1
670 GOTO 1230
671 IF P=32 THEN LET D=2
672 IF P=31 THEN LET D=3
673 IF P=30 THEN LET D=4
674 IF P=29 THEN LET D=5
675 IF P=28 THEN LET D=6
676 IF P=27 THEN LET D=7
677 IF P=26 THEN LET D=8
678 IF P=25 THEN LET D=9
680 REM RIGHT
725 LET P=2
726 PRINT AT D*2-1,6;CHR$ 136
728 LET 01=D*2-1
729 LET 02=6
730 IF A (D,P)=99 THEN PRINT AT 01, 02;CHR$ 128
740 IF A (D,P)=99 THEN GOTO 430
750 IF A (D-1,P)=99 THEN GOTO 810
760 IF A (D+1,P)=99 THEN GOTO 840
770 LET P=P+1
780 IF P>9 THEN PRINT AT D*2-1,24;CHR$ 136
790 IF P>9 THEN GOTO 430
800 GOTO 730
810 IF P<=2 THEN PRINT AT D*2-1,6;CHR$ 180
820 IF P<=2 THEN GOTO 430
825 LET P=P-1
830 GOTO 590
840 IF P<=2 THEN PRINT AT D*2-1,6;CHR$ 180
850 IF P<=2 THEN GOTO 430
855 LET P=P-1
860 GOTO 1000
865 REM UP
870 IF P=17 THEN LET P=9
880 IF P=18 THEN LET P=8
890 IF P=19 THEN LET P=7
900 IF P=20 THEN LET P=6
910 IF P=21 THEN LET P=5
920 IF P=22 THEN LET P=4
930 IF P=23 THEN LET P=3
940 IF P=24 THEN LET P=2
950 LET D=9
955 PRINT AT 19,4+P*2;CHR$ 136
956 LET 01=19
957 LET 02=4+P*2
960 IF A(D,P)=99 THEN PRINT AT 01,02;CHR$ 128
970 IF A(D,P)=99 THEN GOTO 430
980  IF A (D,P-1)=99 THEN GOTO 1040
990  IF A (D,P+1)=99 THEN GOTO 10
1000 LET D=D-1
1010 IF D<=2 THEN PRINT AT 1,4+P*2;CHR$ 136
1020 IF D<=2 THEN GOTO 430
1030 GOTO 960
1040 IF D>=9 THEN PRINT AT 19,4+P*2;CHR$ 180
1050 IF D>=9 THEN GOTO 430
1055 LET D=D+1
1060 GOTO 770
1070 IF D>=9 THEN PRINT AT 19,4+P*2;CHR$ 180
1080 IF D>=9 THEN GOTO 430
1085 LET D=D+1
1090 GOTO 1230
1095 REM LEFT
1100 IF P=9 THEN LET D=2
1110 IF P=10 THEN LET D=3
1120 IF P=11 THEN LET D=4
1130 IF P=12 THEN LET D=5
1140 IF P=13 THEN LET D=6
1150 IF P=14 THEN LET D=7
1160 IF P=15 THEN LET D=8
1170 IF P=16 THEN LET D=9
1180 LET P=9
1185 PRINT AT D*2-1,24;CHR$ 136
1186 LET 01=D*2-1
1187 LET 02=24
1190 IF A (D,P)=99 THEN PRINT AT01,02;CHR$ 128
1200 IF A (D,P)=99 THEN GOTO 430
1210 IF A (D-1,P)=99 THEN GOTO 1270
1220 IF A (D+1,P)=99 THEN GOTO 1300
1230 LET P=P-1
1240 IF P<=2 THEN PRINT AT D*2-1,6;CHR$ 136
1250 IF P<=2 THEN GOTO 430
1260 GOTO 1190
1270 IF P>=9 THEN PRINT AT D*2-1,24;CHR$ 180
1280 IF P>=9 THEN GOTO 430
1285 LET P=P+1
1290 GOTO 590
1300 IF P>=9 THEN PRINT AT D*2-1,24;CHR$ 180
1310 IF P>=9 THEN GOTO 430
1315 LET P=P+1
1320 GOTO 1000
1325 REM GUESS
1330 PRINT AT 21,0;"GRID LINE DOWN 1 TO 8
1340 INPUT G1
1350 PRINT AT 21,0;"GRID LINE ACROSS 1 TO 8
1355 INPUT G2
1356 PRINT AT 21,0;"ENTER * OR SPACE
1357 INPUT G$
1360 PRINT AT G1*2+1,G2*2+6;G$
1370 PRINT AT 21,0;"ANOTHER GUESS Y OR N
1380 INPUT A$
1390 IF A$="Y" THEN GOTO 1330
1400 GOTO 430
1415 FOR L=1 TO 11
1420 FOR M=1 TO 10
1450 IF A (L,M)=99 THEN PRINT ATL*2-1,M*2+4;CHR$ 151
1460 NEXT M
1470 NEXT L
1480 STOP
1490 SAVE "ATOM"
1500 GOTO 10
```

Card tricks

L Cunningham,
Rainham, Essex.

ZX-81

BASED ON A WELL-known television game in which contestants predict the relative values of playing cards, this program will run on a ZX-81 with 16K RAM.

The screen displays two rows of concealed playing cards. In turn each card is revealed from left to right in response to the pressing of keys L — lower — or H — higher. The first card in each row may be changed by pressing key C — change.

Pressing key S — stick — will protect the cards already revealed and transfer play to the opponent. An incorrect prediction will result in all cards to the right of the stick marker being cancelled and play returning to the opponent. The object of the game is to complete five rows of cards before the opponent.

```
 1 REM L. CUNNINGHAM. 1981.
 5 RAND
10 DIM C(15)
20 DIM P(15)
30 DIM L(15)
40 DIM S(15)
50 DIM B$(14,2)
51 LET B$(2)=" 2"
52 LET B$(3)=" 3"
53 LET B$(4)=" 4"
54 LET B$(5)=" 5"
55 LET B$(6)=" 6"
56 LET B$(7)=" 7"
57 LET B$(8)=" 8"
58 LET B$(9)=" 9"
59 LET B$(10)="10"
60 LET B$(11)="J "
61 LET B$(12)="Q "
62 LET B$(13)="K "
63 LET B$(14)="A "
70 LET A=0
80 LET I=6
90 FOR P=2 TO 27 STEP 5
100 FOR R=5 TO 7
110 PRINT AT R,P; CHR$ 136; CHR$ 136; AT R+9,P;
    CHR$ 136; CHR$ 136
120 NEXT R
130 NEXT P
140 PRINT AT 5,5; CHR$ 23; AT 14,5; CHR$ 23;
    AT 6,0; CHR$ 146
```

(continued on next page)

(continued from previous page)

```
150 PRINT AT 1,2; "TURN OF THE CARDS."
160 PRINT AT 3,2; "player one"; AT 3,20;
    "SCORE ";0
170 PRINT AT 12,2; "player two"; AT 12,20;
    "SCORE ";0
180 IF A>0 THEN GOTO 230
190 LET A=INT(RND*13)+2
200 PRINT AT I,2; B$(A)
210 LET L(I)=A
220 LET P(I)=2
225 LET C(I)=2
230 LET X=INT(RND*13)+2
240 IF INKEY$="L" THEN GOTO 280
250 IF INKEY$="H" THEN GOTO 280
260 IF INKEY$="S" THEN GOTO 500
270 IF INKEY$="C" AND C(I)=2 THEN GOTO 190
275 GOTO 240
280 LET A$=INKEY$
290 LET C(I)=C(I)+5
300 PRINT AT I,C(I); B$(X)
310 IF A$="H" AND X<=A THEN GOTO 400
320 IF A$="L" AND X>=A THEN GOTO 400
330 IF C(I)=27 THEN GOTO 700
340 LET A=X
345 PAUSE 50
350 GOTO 230
400 PAUSE 100
410 FOR W=P(I)+5 TO 27 STEP 5
420 PRINT AT I,W; CHR$ 136; CHR$ 136
430 NEXT W
440 GOTO 560
500 LET L(I)=A
510 LET P(I)=C(I)
520 FOR W=5 TO 30 STEP 5
530 PRINT AT I-1,W; CHR$ 0
540 NEXT W
550 PRINT AT I-1,C(I)+3; CHR$ 23
560 IF I=6 THEN PRINT AT 6,0; CHR$ 0;
    AT 15,0; CHR$ 146
570 IF I=15 THEN PRINT AT 6,0; CHR$ 146;
    AT 15,0; CHR$ 0
580 IF I=6 THEN GOTO 610
590 LET I=6
600 GOTO 620
610 LET I=15
620 LET C(I)=P(I)
630 LET A=L(I)
640 GOTO 180
700 LET S(I)=S(I)+1
705 PRINT AT I-3,26; S(I)
710 IF S(I)=5 THEN GOTO 800
720 FOR P=2 TO 27 STEP 5
730 FOR R=I-1 TO I+1
740 PRINT AT R,P; CHR$ 136; CHR$ 136;
    AT R,P+3; CHR$ 0
750 NEXT R
760 NEXT P
770 PRINT AT I-1,5; CHR$ 23
780 LET C(I)=2
785 LET A=0
790 GOTO 180
800 FOR W=2 TO 30
810 FOR R=I-1 TO I+1
820 PRINT AT R,W; CHR$ 0
830 NEXT R
840 NEXT W
850 PRINT AT I-1,11; "GAME OVER"; AT I+1,8;
    "I AM THE WINNER"
860 PAUSE 200
870 CLS
880 GOTO 5
890 SAVE "CARDS"
900 GOTO 5
```

(NEGATIVE CHARACTERS SHOWN IN LOWER CASE.)

LINES 50 TO 63 MAY BE ENTERED AS DIRECT COMMANDS IF THE COMMAND "RUN" IS AVOIDED.

Guessing game

J Wise,
Barnet, Hertfordshire.

VIC-20

HERE IS A program for the Vic-20. It will run without any extra memory. I also have some tips for anyone intending to buy a Vic. Before you do, check that the transformer does not have a blue base. These were faulty and should have been returned to Commodore. It should say "Made in Germany" on the box. Ones made in Japan are display models and do not have as high a quality picture. Ask your dealer if it is distributed through Commodore. If it is not, it is likely not to be tuned correctly to suit British TV.

```
1 POKE 36879,27:PRINT"(BLU)"
10 PRINT 2(CLR)GUESSING GAME"
30 PRINT:PRINT:PRINT"I HAVE THOUGH OF A":PRINT"NUMBER BETWEEN 1 AND":PRINT"20.
   YOU MUST TRY AND"
40 PRINT "GUESS IT. I WILL COUNT"
50 PRINT "THE NUMBER OF GUESSES."
55 B=1
60 PRINT:A=INT(RND(1)*20)+1
70 PRINT "GUESS "B;:INPUT C
80 B=B+1
90 IF C<A THEN 500
100 IF C>A THEN 600
110 IF C=A THEN 700
500 POKE 36878,15:POKE 36877,128: FOR X=1 TO 2500: NEXT X
505 POKE 36877,0
510 PRINT"(BLK)(RVS ON)TOO LOW!!!(BLU)"
520 GOTO 70
600 POKE 36878,15:POKE 36875,200:FOR X=1 TO 2500:NEXT X:POKE 36875,0
610 PRINT"(PUR)(RVS ON)TOO HIGH!!!(BLU)"
620 GOTO 70
700 POKE 36878,15:FOR N=1 TO 7:POKE 36875,170:FOR X=1 TO 100:NEXT X:POKE
36875,0:NEXT N
710 PRINT"(BLK)RIGHT! YOU TOOK";B-1;"GUESSES"(BLU)"
711 PRINT"(RVS ON) PRESS ANY KEY"
713 GET T$:IF T$="" THEN 713
714 PRINT"(CLR)";:RUN
```

Lateral Scroll

Darrin Hill,
Saintbridge, Gloucester.

ZX-81

THIS MACHINE-CODE program scrolls the screen from right to left. It will only work on a 16K ZX-81 since it works by Poking on to the screen. The main section scrolls one horizontal line, whilst the section beforehand moves it down the screen until it has all been scrolled. Use this program to enter the machine code a number at a time.

```
10 REM (54Xs)
20 LET A=16514
30 INPUT B
40 POKE A,B
50 PRINT B;",";
60 LET A=A+1
70 GOTO 30
```

Check that those printed on the screen correspond to the code, and when it has all been entered stop the Basic program by entering "P".

Before attempting anything else, enter, as a direct command:

```
RAND USR (16514)
```

If, after a few seconds, the computer does not reply with a "0/0" report code, or crashes, then you made a mistake. Otherwise, try this demonstration program, remembering not to delete line 10:

```
10 REM (MACHINE CODE)
20 LET A=10
30 PRINT AT A,31;"*"
40 LET A=A+(INKEY$="6")+(A=0)
   -(A=21)-(INKEY$="7")
50 RAND USR (16514)
60 GOTO 30
```

The asterisk on the right of the screen is moved up by "7" and down by "6". You should find that it forms a tail due to the scrolling.

You do not have to scroll the whole screen. You can isolate it by Poking certain locations.

```
POKE 16530,A
POKE 16531,B
POKE 16515,C
POKE 16516,D
```

A=231, B=0, C=0 and D=0 confine it to the top 7 lines. A=214, B=2, C=231 and D=0 confine it to the bottom 13 lines. A=74, B=1, C=231 and D=0 keep it in the centre and, so that the whole screen is scrolled again, A=214, B=2, C=0 and D=0.

To decide on your own extremes Poke into 16530 and 16531 the hexadecimal values of a number between 0 and 22 multiplied by 33 and adding 33 to the answer. This sets the lower line. In all cases it must be greater than the next value, which is a number between 0 and 22 multiplied by 33 and its hexadecimal values Poked into 16516 and 16515.

Finally, since the program only scrolls from right to left it can be altered so that it works in the opposite direction.

```
POKE 16530,0
POKE 16531,0
POKE 16515,214
POKE 16516,2
POKE 16536,1
POKE 16537,33
POKE 16538,0
POKE 16539,237
POKE 16540,66
POKE 16553,43
POKE 16554,43
POKE 16562,35
```

```
DECIMAL          Z80 ASSEMBLER      COMMENTS      84          LD D,H          STORES VALUE
17,0,0           LD DE,0                          93          LD E,L          OF HL IN DE
98               LD H,D             LETS          237,75,12,64  LD BC,(D FILE)
107              LD L,E             HL=DE         33,0,0      LD HL,0
175              XOR A                            9           ADD HL,BC
125              LD A,L             POKES L       175         XOR A
50,164,64        LD(16548),A        INTO 16548    60          INC A
175              XOR A                            35          INC HL
124              LD A,H             POKES H       35          INC HL
50,165,64        LD(16549),A        INTO 16549    254,32      CP 32           IF A=32 THEN
1,214,2          LD BC,726          IF            40,7        JR Z,7          JUMP 7
237,66           SBC HL,BC          HL=726        70          LD B,(HL)       LETS B=GRAPHIC
200              RET Z              THEN RETURN   54,0        LD(HL),0        CLEARS GRAPHIC
98               LD H,D                           43          DEC HL          POKES GRAPHIC IN
107              LD L,E                           112         LD(HL),B        NEW POSITION
1,33,0           LD,BC,33           INCREASES     24,242      JR NEXT
9                ADD HL,BC          HL BY 33      24,205      JR NEXT
```

Enterprise rescue

D E Healey,
Coseley, West Midlands.

ZX-81

A FEDERATION starbase has been destroyed by a Klingon attack and the USS *Enterprise* has just arrived in the sector to pick up survivors. You must guide the life capsules containing the survivors into the cargo deck of the *Enterprise.* The capsules have limited oxygen supplies so you must act as quickly as possible. Beware of space mines!

You guide the capsules to the *Enterprise* by using the keys "1", ".", "A" and "P" which move it up, down, left, and right respectively.

You score for each capsule collected and gain time. The game ends either when you run out of time or when one of the capsules hits an invisible space mine.

```
10 LET E=13
20 LET T=200
30 LET S=PI-PI
40 LET Y=2
50 LET X=Y
60 LET A=PI/PI
90 CLS
100 LET H=INT(RND*E)
110 LET I=INT(RND*E)
120 PRINT AT H,I;"graphic 7 graphic Q graphic E graphic 1"
130 LET J=INT(RND*E)
140 LET K=INT(RND*E)
150 LET T=T-2
160 IF T=PI-PI THEN GOTO 600
200 PRINT AT Y,X;"+"
210 IF Y=J AND X=K THEN GOTO 500
220 IF Y=H AND X=I THEN GOTO 400
230 PRINT AT Y,X;" space"
240 IF INKEY$="1" THEN LET Y=Y-A
250 IF INKEY$="." THEN LET Y=Y+A
260 IF INKEY$="A" THEN LET X=X-A
270 IF INKEY$="P" THEN LET X=X+A
280 IF Y<PI-PI THEN LET Y=PI-PI
290 IF X<PI-PI THEN LET X=PI-PI
300 IF X>19 THEN LET X=19
310 GOTO 130
400 LET S=S+5
410 IF INT(RND*16)=E THEN LET T=T+90
420 LET T=T+10
430 CLS
440 PRINT T
450 PAUSE 30
460 GOTO 90
500 PRINT AT Y,X-A;">*<"
510 PAUSE E
600 CLS
610 PRINT S
```

On the dump

C Perry,
Farnborough, Hampshire.

MZ-80K

MY PROGRAM dumps memory on to the screen of the MZ-80K and should be useful for anyone trying to write machine-code subroutines. The program was written in machine code to make it faster and to exploit the monitor subroutines to the full. All the numbers used by the program are either two- or four-character hexadecimal numbers.

When you run the program, there is a short delay as the machine code is loaded into the memory. The computer will then print:

```
ADDRESS ?
```

The computer is asking for a four-character hexadecimal number from which you want memory to be dumped. For example:

```
ADDRESS ?
D000 (CR)
```

The computer will respond to this by showing a flashing cursor. This tells you that the computer is waiting for a command key to be pressed. There are five key commands, and it

(continued on next page)

(continued from previous page)

is easy for anybody with even a small knowledge of machine-code programming to add others. The commands are:

(SHIFT) X

This dumps memory from the predefined address in the form

D000 01 00 FF 10 2F 3C 5A 95

The flashing cursor then reappears showing that the program is waiting for the next key command. If the shift-X key is then pressed again, the next eight bytes of memory will be displayed:

D008 00 F6 CF 49 1A CD 00 4D

The command C allows you to redefine the address that you wish to dump. The shift-E command allows you to edit the information you have dumped. In this mode, full screen editing is supported. When you have modified a line the CR key must be pressed or the change in the memory will not be made. The editing mode is a closed loop so that control does not return to the main program after the CR key has been pressed. The only way to leave the editing mode is to press shift-break, to return to the main part of the program where the key commands can be used.

Shift G will call a machine-code subroutine. The starting address of the subroutine should be entered using the C command, and then the shift-G command must be pressed. No other command keys should be used between these two commands as they will alter the start address. Return from a subroutine is via the normal Z-80 return codes.

```
C.PERRY   MEMORY DUMP FOR THE MZ-80K


10 DATA 65,68,68,82,69,83,83,32,63,13
20 DATA 17,80,18,205,21,0,205,6,0
30 DATA 17,0,18,205,3,0,205,16,4,205
40 DATA 179,9,254,18,32,1,201,254,3,32
50 DATA 3,0,24,222,254,88,32,20,205,186
60 DATA 3,6,8,205,12,0,126,205,195,3
70 DATA 35,16,246,205,9,0,24,216
80 DATA 254,69,32,33
90 DATA 17,0,18,205,3,0,205,30,0,40,239
100 DATA 205,16,4,19,19,19,19,19,6,8
110 DATA 205,31,4,119,19,0,35,16,246
111 DATA 0,24,223
115 DATA 254,71,32,3,205,0,0,24,208,233,0,0,0
200 LET M=24: REM *** USER MEMORY OF MACHINE ***
210 LET M=M+4: REM *** ADD 4 FOR 4K MONITOR ROM ***
220 LET M1=1024*M: REM *** TOP OF USER MEMORY ***
225 LIMIT (M1-202)
230 FOR A=M1-120 TO M1-5
240 READ B: POKE A,B
250 NEXT A
270 L=M1-120: L1=M1-200: LH=INT(L/256): LL=INT(L-256*LH+0.5)
280 POKE L+11,LL: POKE L+12,LH
290 LH=INT(L1/256): LL=INT(L1-256*LH+0.5)
300 POKE L+20,LL: POKE L+21,LH
310 POKE L+72,LL: POKE L+73,LH
311 LH=INT((M1-7)/256): LL=INT((M1-7)-256*LH+0.5)
312 POKE (M1-11),LL: POKE (M1-10),LH
320 USR(L+10)
330 END
```

Fighter pilot

C M Medley,
Stapleford, Nottingham.

ZX-81

IN THIS GAME you are a fighter pilot trying to repel an invasion by enemy aircraft. You have a total of five aircraft armed with air-to-air missiles. Each enemy plane shot down increments your score by one. Missed planes are also counted. If you crash your aircraft into the enemy, or delay firing too long and are caught in the blast of your own missile, you lose that aircraft. Your score will include the aircraft brought down by collison.

Keys 6 and 7 manoeuvre the aircraft in the direction of the cursors, 0 fires the missile. As the program only tests whether a key is being pressed once each cycle, the keys should be held down. The logic in line 130 is to prevent an aircraft skipping over the missile. This program is written for the ZX-81 with 16K RAM. However, if the frills are removed, you could use the basic idea on a standard machine.

```
10   LET S=0
20   LET C=0
30   LET A=1
40   LET FX=27
50   LET FY=10
60   LET EX=0
70   LET EY= INT(RND*20)+1
80   LET C=C+1
90   LET Y=FY
100  LET X=FX
110  CLS
120  PRINT AT FY,FX; "[GRAPHICS]" - Graphics/Shift/6,f,6,Q.
130  IF Y=EY AND (X=EX+1 OR X=EX+2 OR X=EX+3) THEN GOTO 270
140  PRINT AT EY,EX; "[GRAPHICS]" - Graphics/Shift/W,6,F,6.
150  LET EX=EX+2
160  IF EX>27 THEN GOTO 60
170  LET A$=INKEY$
180  IF A$= "6" AND FY<20 THEN LET FY=FY+1
190  IF A$= "7" AND FY>0 THEN LET FY=FY-1
200  IF A$= "0" OR X<27 THEN LET X=X-1
210  IF A$= "0" THEN GOTO 500
220  IF X<27 AND X>0 THEN GOSUB 250
230  IF X<27 AND X>EX THEN GOTO 110
240  GOTO 90
250  PRINT AT Y,X; "<="
260  RETURN
270  IF EX<=23 THEN PRINT AT 0,0;"AIRCRAFT DESTROYED."
280  LET S=S+1
290  IF EX>23 THEN PRINT AT 0,0;"YOU DESTROY ATTACKING AIRCRAFT",
     "BUT YOU ARE ALSO DESTROYED."
300  PRINT "YOU HAVE BROUGHT DOWN: ",,S;" AIRCRAFT.";
310  IF C-S=0 OR C-S>1 THEN PRINT TAB 16;C-S;" HAVE ESCAPED."
320  IF C-S=1 THEN PRINT TAB 16;C-S;" HAS ESCAPED."
330  FOR N=1 TO 100
340  NEXT N
350  IF EX>23 THEN GOTO 370
360  GOTO 60
370  LET A=A+1
380  IF A=6 THEN GOTO 440
390  PRINT
400  PRINT "DO YOU WISH TO SCRAMBLE","FIGHTEER NO.";A;"? (Y/N)"
410  INPUT B$
420  IF B$<>"Y" THEN GOTO 490
430  GOTO 60
440  PRINT
450  PRINT "ALL FIGHTERS HAVE BEEN SCRAMBLED";"DO YOU WISH TO TRY
     AGAIN? (Y/N)"
460  INPUT C$
470  IF C$<>"Y" THEN GOTO 490
480  RUN
490  CLS
500  STOP
```

Keyboard reverse

Derek Robinson,
Bradford,
West Yorkshire.

ZX-81

THIS PROGRAM effectively reverses the keyboard thus enabling Inkey$ to operate on the graphic symbols so that they can be printed rapidly in a continuous manner without resort to the shift key. With my software, printing graphics can be controlled by a program, or by the cursor keys. This makes unlimited picture drawing possible.

The symbols can be changed directly by pressing the key bearing the symbol required. Alternatively, they can be interchanged with the normal Inkey$ character, or erased by a flashing screen cursor, again, repeatedly and without limit.

To run the second program — N may be larger or smaller than 10 — input pairs of code numbers to correspond to the two symbols on the selected keys.

Enter the graphics-symbols code first and having input N pairs, the screen will clear. Depress the symbol you require and it will appear on the screen. You can print it repeatedly leaving a trail of the symbol in the direction selected by the cursor including, 4,9,T and U — 45° movement.

To change to another graphic symbol, press M followed by the symbol key. To erase, press Rubout then a movement cursor; to change to the normal character key or vice versa, press the full stop.

```
DEREK ROBINSON   PICTURE PRINTER
10 REM GRAPHIC SYMBOL PRINTER
20 REM COPYRIGHT DEREK ROBINSON
30 LET A$=CHR$38
40 LET B$=CHR$8
50 IF INKEY$="A" THEN PRINT B$
60 GOTO 50
5 REM PICTURE PRINTER
6 REM COPYRIGHT DEREK ROBINSON
10 DIM A$(10)
20 DIM B$(10)
30 DIM C$(10)
40 FOR N=1 TO 10
50 INPUT G
60 INPUT H
70 LET A$(N)=CHR$G
80 LET B$(N)=CHR$H
90 PRINT TAB 1;A$(N) TAB6;B$(N)
```

```
100 NEXT N
110 CLS
120 LET X=0
130 LET Y=0
140 LET Z=1
150 FOR N=1 TO 10
160 IF INKEY$=B$(N) THEN GOTO 190
170 NEXT N
180 GOTO 150
190 LET C$(N)=A$(N)
200 LET U$=INKEY$
210 IF U$="T" OR U$="5" OR U$="4" THEN LET
X=X-(X>Z)
220 IF U$="U" OR U$="8" OR U$="9" THEN LET X=X+(X<31)
230 IF U$="T" OR U$="6" OR U$="U" THEN LET Y=Y+(Y<21)
240 IF U$="4" OR U$="7" OR U$="9" THEN LET Y=Y-(Y>Z)
250 IF U$="M" THEN GOTO 160
260 IF U$="0" THEN LET C$(N)=" "
270 IF U$="." THEN LET C$(N)=B$(N)
280 PRINT AT Y,X;B$(N); AT Y,X;C$(N)
290 GOTO 200
```

Atom art

Martin Campbell,
Barlanark, Glasgow.

ATOM

I HAVE WRITTEN a program which allows you to draw pictures in high resolution. The assembler at the start is used as a Inkey$ function.

The main loop is from lines 25 to 300. Lines 40 to 140 determine what keys are being pressed and then branch to the appropriate subroutine. Instructions are also included but these can be left out if you are short of memory.

```
0 REM ATOM ART
1 P. $21;P=#21C
2□JSR#FE71;BCS P+9;JSR P+11
3 STA  #032C;RTS;LDA @#FF;BNE P-6
4 PHP;JMP#FEA7;□;P.$6;K=0
5 Z=13;G=1;P.$12
10 IN."'STARTING POINTS"X,Y .
11 GOSUB 1000
20 CLEAR 4
25 LINK #21C
26 F.L=0 TO 6; N.L
30 PLOT Z,X,Y
40 IF K=65 6.a
50 IF K=81 6.q
60 IF K=87 6.w
70 IF K=69 6.e
80 IF K=68 6.d
90 IF K=67 6.c
100 IF K=88 6.x
110 IF K=90 6.z
120 IF K=48 6.20
130 IF K=49 6.o
140 IF K=50 6.t
150 G.25
200aX=X-1;G.25
210qX=X-1;Y=Y+1;G.25
220wY=Y+1;G.25
230eX=X+1;Y=Y+1;G.25
240dX=X+1;G.25
250cX=X+1;Y=Y-1;G.25
260xY=Y-1;G.25
270zX=X-1;Y=Y-1;G.25
2806Z=13;G.25
290tZ=15;G.25
300 G.25
1000 P."            ATOM ART"''            --------"''
1010 P." THIS PROGRAM ALLOWS YOU TO DRAW PICTURES WITH THE ATOMS HIGH"
1020 P." RESOLUTION GRAPHICS."'
1030 P." USE THE KEYS AROUND 'S' TO DRAW"''
1040 P." PRESS '1' TO DRAW "''
1050 P." PRESS '2' TO RUBOUT"''
1060 P." PRESS RETURN PLEASE "'
1070 LINK#FFE3
1080 P.$12
1090 P.'''"IF YOU WANT TO DRAW SLOW THEN"'
2000 P." PRESS '8' OR IF YOU WANT TO"'
2010 P." DRAW FAST THEN PRESS '9' "'
2020 P." PRESS '0' TO RESTART"
2030 P.'" PRESS ANY KEY TO START.";LINK#FFE3;RETURN
```

Basic truth

P J Newbury,
Croydon, Surrey.

ZX-81

PAUL BRITTAIN'S "Free memory" machine-code program — Software File, November 1981 — can be entered very simply by using Basic characters in place of the decimal machine-code instructions. All you do is enter the following line:

1 REM j,?,?,T,GOSUB,?,0,RND,GOSUB,PI,
FAST,AT,CLEAR,5,s,RND,Y,2,GOSUB,?,TAN

Where j means inverse J and s means space. The commas are only for clarity and are not part of the line. To enter keywords use Then, the keyword and thirdly edit out Then using the cursor position keys followed by Rubout.

After entering this line with Newline, enter the following as direct commands:

```
POKE 16515,103
POKE 16516,111
POKE 16519,75
POKE 16533,71
```

The program is ready for use at any time by:

```
PRINT USR 16514
```

It is useful to have this program in the machine whenever you are writing a program. By saving it on tape, you can enter it before your program. Just remember not to use line 1 in your program. The four Poke commands will have to be entered each time you load it.

The lack of Read and Data statements in ZX-81 Basic can be most frustrating. The most common use for such commands is to get the Nth number from a list of numbers. Here is one solution to the problem.

Each number in the list must have the same number of characters including the sign and any decimal point. This can easily be achieved with a few extra zeros. The two program lines are:

LET A$ = "(your list of numbers entered one after the other)"
LET Z = VAL A$((N-1)*X + 1 TO (N-1)*X + X)

X is the number of characters in each number. Any additional zeros included to make every number the same number of characters are removed by the Val statement. N can, of course, be changed to any other variable convenient to your program, as can Z.

Piano keys

Nalin Sharma,
London E17.

VIC-20

THIS PROGRAM will allow you to play all 38 notes shown on page 135 of the Vic-20 manual. The keys which can be used begin from the second row down:

```
Q W E R T Y U I O P @ *
A S D F G H J K L : ; = (Ret)
Z X C V B N M , . /
```

As the cursor keys are used: line 6 stops them repeating and so when you break the program a Poke 650,0 will restore the normal repeat functions. If you want silence, hit the space bar — line 100.

A feature of the program is that although you choose your voice at the beginning, you can change it in the middle of the program by pressing 1,2,3 or 4 to obtain the respective voice — line 85.

```
6 POKE 650,127
10 PRINT "VIC 20 PIANO KEYS"
20 INPUT "WHICH VOICE";S
30 IF S<1 OR S>4 THEN 20
40 S=INT(S)+36873
50 POKE 36878,15
55 DIM A(100)
60 READ N:IF N=0 THEN 80
70 READ A(N)
75 GOTO 60
80 GET A$:IF A$="" THEN 80
85 IF A$="1" OR A$="2" OR A$="3" OR A$="4" THEN GOSUB 180:GOTO 80
90 N=ASC(A$)
100 IF N=32 THEN POKE S,0:GOTO 80
110 POKE S,0
120 FOR T=1 TO 10:NEXT
130 POKE S,A(N)
140 GOTO 80
150 POKE S,0
180 POKE S,0:K=VAL(A$):S=K+36873:RETURN
200 DATA 81,135,87,143,69,147,82,151,84,159,89,163,85,167,73,175
210 DATA 79,179,80,183,64,187,42,191,92,195,65,199,83,201,68,203
220 DATA 70,207,71,209,72,212,74,215,75,217,76,219,58,221
230 DATA 59,223,61,225,13,227,90,228,88,229,67,231,86,232,66,233
240 DATA 79,235,77,236,44,237,46,238,47,239,17,240,29,241,0
```

FOOTBALL MANAGER

A GREAT NEW GAME FROM

Addictive Games

for ZX81, ZX80, TRS80, VIDEO GENIE

«JUST LOOK AT THESE FEATURES»

★4 Divisions ★ Promotion & Relegation★
★F.A. Cup ★ Full League Tables★
★Transfer Market (Buy and Sell Players)★
★Pick your Team for each Match (but watch out for Injuries!)★
★As many Seasons as you like★
★7 levels of Play (from Beginner to Genius!)★
★Managerial Rating (tells you how good you REALLY are!)★
★Save Game Facility (continue again another time)★

–All this and much much more packed tightly into 16K RAM –

"IF YOU LIKE FOOTBALL
YOU'LL LOVE THIS GAME"

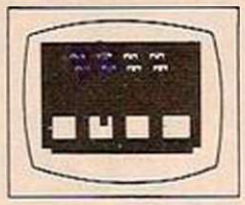
HARDWARE REQUIRED:–

ZX81/ ZX80	TRS80/ Video Genie
8K ROM 16K RAM	LEVEL II 16K RAM

TO ORDER SEND CHEQUE/PO FOR £9.95 MADE PAYABLE TO **ADDICTIVE GAMES** at 267B, Conniburrow Boulevard, MILTON KEYNES, MK14 7AF
(Please allow 28 days for Delivery)

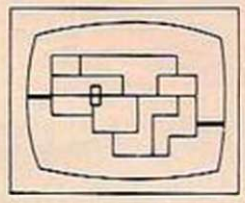
MACRONICS

ZX81 26 Spiers Close, Knowle, Solihull, West Midlands B93 9ES England **ZX80**



1K Space Intruders £5.00
3K Super Version £6.00
Written in machine code to give fast moving 'Flicker Free' graphics. A superb achievement.
Supplied on cassette with listing

16K High Resolution £4.00 (192x184) graphic pictures
Never before achieved on the ZX. Create your own artwork.
Supplied on cassette with listing and demonstration picture.



9K Nightmare Park £3.75
The park of DEATH — can you get through this nightmare. No human has yet succeeded. Confronted by all sorts of 'Happenings' you'll be taken to your wits end.
Supplied on cassette only.

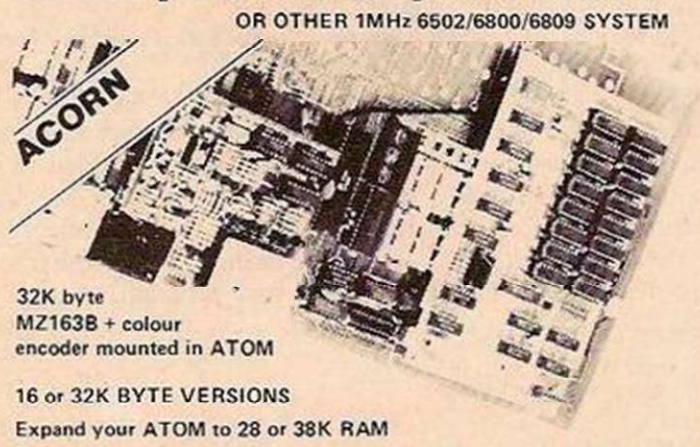
Specify 4K, 8K ROM or ZX81 when ordering.

NEW INTERACTIVE GRAPHICS for the 16k ZX81

DRAGON MAZE... are you cunning enough to evade the dragon? you are impeded by darkness; the walls are only displayed when you make a bad move, this gives the dragon an advantage. You have to play by the rules - the dragon breaks them when he gets angry. Fun for all ages!
Cassette and listing..... £5.00 *(for ZX81 only)*

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

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.

We welcome Access · 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)

Books and bits for ZX, Atom

The Explorer's Guide to the ZX81

IF YOU'VE GOT A ZX81 THEN YOU NEED THIS BOOK!
Programs for 1K RAM, and programs for 16K RAM. Games, Business and Engineering Applications. RAM & I/O Circuits. Useful ROM Routines. Hints and Tips. And Much Much More, for only £4.95

NEW!

The ZX80 Magic Book

With 8K ROM/ZX81 Supplement
Games programs, computer music, converting programs written in other BASICS, improving the picture RAM & I/O 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 ZX80/80

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

ZX & Atom IC's & Connectors

S.a.e. for list.

TIMEDATA

Dire straits

BY ANTHONY ROBERTS

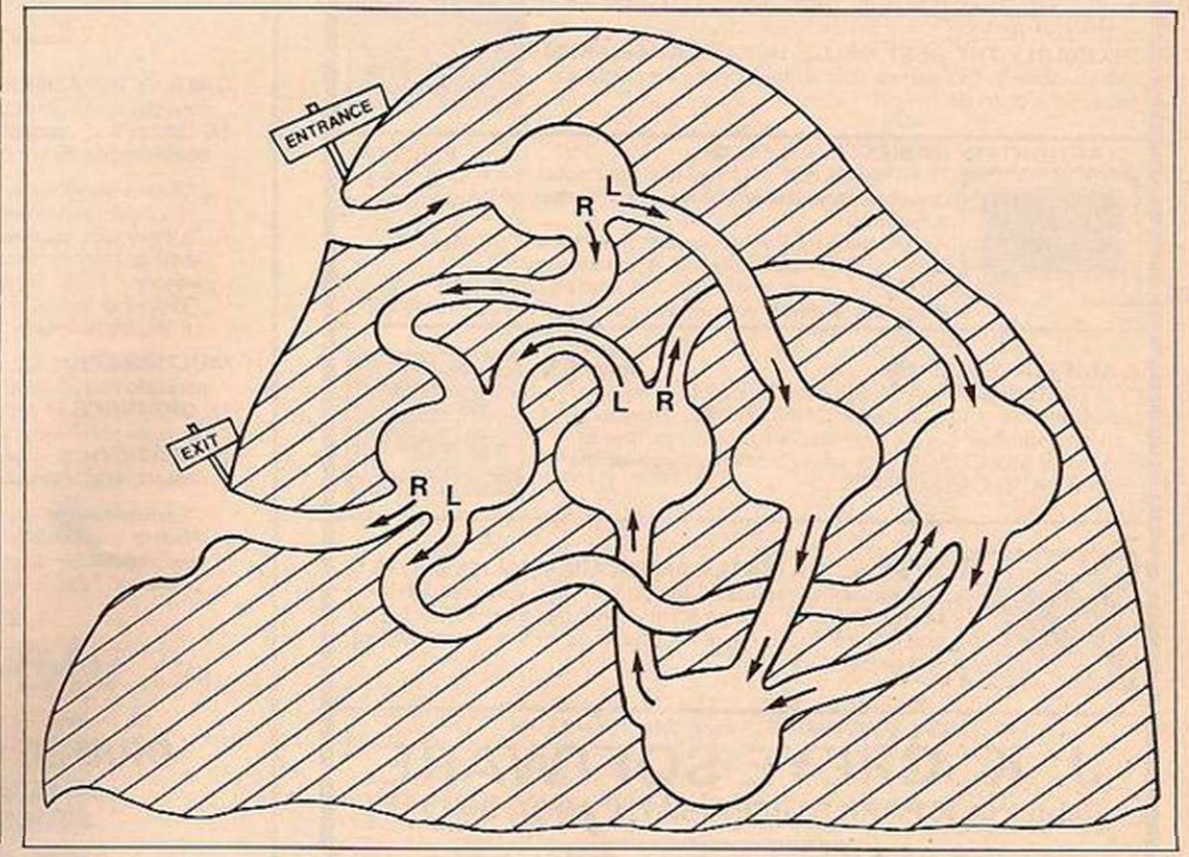
THE WIZARD One-eye has you in straits again. He has you and 24 others herded into a cage outside the Troll's Tor — a cave system in which each cave contains a troll, a pile of bones and a chest of gems. The trolls, curiously, have been numbered 1,2,3,4,5 and 6 by branding iron, and each will give the cave traveller that many gems as he passes through his cave. The wizard simply wants you to enter the caves, wander around and leave with some of the trolls' gems.

As you may have guessed, there are several catches: each troll eats every third person to go through his cave. When he does so, though, he reclaims any gems the traveller may have. If there are more gems than the troll started with, he leaves the excess jewels in a pile in the middle of the cave and goes to sleep. So if you meet a sleeping troll you may take these gems and continue on your way. Invariably though, the troll wakes just as you leave, ready for the next man to pass.

All passages are one-way, and you must always take the left exit of a cave if you have an even number of gems, or the right if you have an odd number — in those caves that have two exits.

You have the cave map but you do not know which troll each cave contains. You see the first four men disappear, then one escapes with five gems, then two men disappear, then the eighth makes it with 35 gems and the tenth with five. You, of course, see that you must go in as the 17th, 22nd, or 24th man in order to survive.

How many gems did the wizard obtain in total?



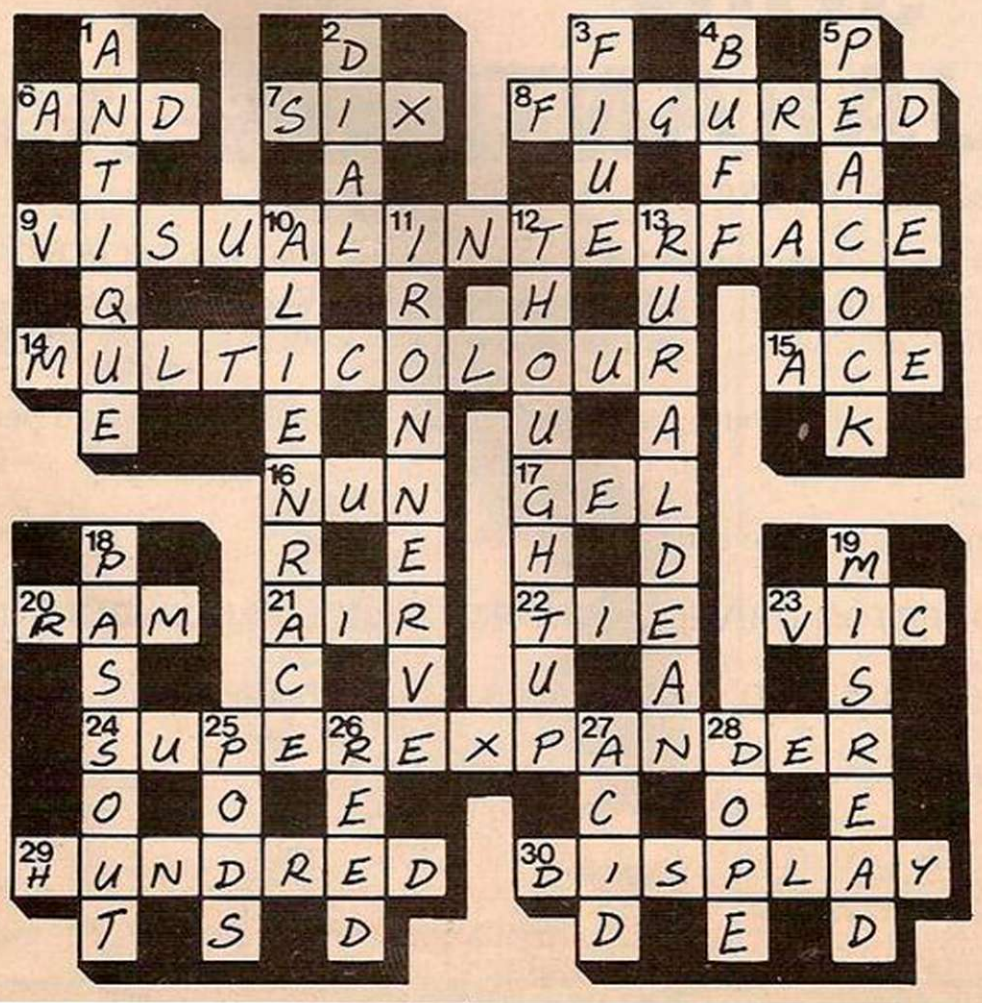
A £15 book token will be awarded to the first correct solution drawn from the competition bag. All entries must be at the *Your Computer* offices by the last working day in March. The name of the winner, the solution, and a competition report will be published in the May issue of *Your Computer*.

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

THE JANUARY Vic-20 crossword competition drew a large response. Most of you found the correct solution with little difficulty, and exercised considerable ingenuity in completing the sentence "I did not have to return the power supply on my Vic-20, but . . .". Deciding on a winner was not easy, but after some debate we picked Alan Westwood of 97 Trentham Street, Southfields, London SW18 5DH, for his "Veni, vidi, Vic Twenty". A Vic-20 is on its way.

The January crossword solution.



The last word on the subject goes to Andrew Bennett of Pembroke College, Cambridge, who revealed "My psychiatrist told me I should".

The Orc's Egg competition published in our January issue had one slight flaw — it was insoluble.

The mistake in the puzzle was the instruction "Find a gem lying on the floor" in the cave between the Orc and the Troll. The instruction should have read "Exchange a coin for a gem lying on the floor".

The solution to the corrected puzzle lies in the equation $\sum A = 2^A - 100$. The answer to this equation is A = 7, so the number of gems needed to escape from One-Eye is $\sum 7$ or 28. A simple program to solve this puzzle is:

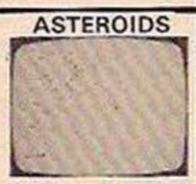
```
10 N=1:D=1
20 S=((N+1)*N/2)+100:D=D*2
30 IF S=D then 50
40 N=N+1:GOTO 20
50 PRINT "BORROW ";S-100;"GEMS"
60 END
```

Despite the error in the puzzle, most of you realised that the answer we were looking for was 28, though T Bate of Lympstone, Devon, produced a solution of 1,002 gems. The neatest solution was provided by Margaret Evans of The Coppins, Stocks Bank Road, Mirfield, Yorkshire WF14 0ES. She accidentally dropped a coin when collecting the Orc's Egg, enabling her to escape safely. A £15 book token is on its way to her. ■

ZX81 GAMES

FED UP WITH BEING RIPPED OFF?
HAVE YOU BOUGHT
BORING/WORTHLESS/RUBBISH GAMES?
DON'T DESPAIR, TRY THESE!

ASTEROIDS



GAMESTAPE 1, for 1K **only £3.95**
10 games incl. ASTEROIDS, UFO, CODE, BOMBER, GUILLOTINE, ETC.
PROBABLY THE BEST VALUE 1K TAPE AVAILABLE!
We've done in 1K, games that some of our competitors required 16K to do!

STARFIGHTER

GAMESTAPE 2, for 16K **only £4.95**
*STARFIGHTER . . . You are fighting at the end of the universe, how many enemy can you destroy? A graphic simulation.
PYRAMID . . . Can you move the PYRAMID? Make a mistake and it will collapse! A thinkers game.
ARTIST . . . become an ARTIST, then use the 10 memories to store your drawings. Incl. SAVE, COPY, etc.

GAMESTAPE 3, for 16K **only £4.95**
*CATACOMBS . . . A Multi-Level Graphics Adventure. You are alone and lost in the CATACOMBS. How long can you survive? Before you starve to death, or one of the many MONSTERS gets you! Can YOU discover the secrets of the CATACOMBS.

3D MONSTER MAZE GAMESTAPE 4, for 16K only £5.95
Unbelievable Graphics! Can you find your way through the Maze? The EXIT is there somewhere, but then so is a T.REX and its after YOU! All in 3D, you've never seen anything like this before!

*GAMES MARKED * incl. Machine Code*

J. K. GREYE SOFTWARE

Dept. YC, 16 PARK STREET, BATH, AVON BA1 2TE

Trade enquiries welcome

BRIDGE SOFTWARE

Quality Software

"I have bought numerous other items of software . . . Yours are excellent . . . They LOAD well, have perfect instructions . . . the most user-friendly I have ever met." (P.R. Notts)

NEW! 16k RAM Pack for the ZX81 £36-
including FREE "GALAXY INVADERS" cassette

ZX81 Software

SAMPLE PRICES

GALAXY INVADERS (requires minimum 4K RAM)
cassette and instructions £3.00
1K GAMES (5 games — no additional memory needed)
cassette and instructions £3.00

"Just a short note to say how good your Space Invader cassette is . . . I will recommend your company any day." (S.A.R. Preston)
"I have just received your cassette of GALAXY INVADERS which I think is the best on the market . . . I am very pleased with your quick service." (S.C. Beds.)
"Enjoying 'GAMES' very much — 'Letter Square' is quite addictive." (F.W. Manchester)

MULTIGRAPHICS 2.3 (requires minimum 16K RAM)
cassette and 20 page illustrated Manual £4.50
1K GRAPHICS (4 programs — no additional memory needed)
cassette and instructions £3.00
1K STATISTICS (4 programs — no additional memory needed)
cassette and instructions £3.00

*"I acknowledge receipt of . . . MULTIGRAPHICS and STATISTICS. Having experienced nothing but trouble with ********'s software, I was agreeably surprised by the good quality and flexibility of your products." (V.S. Berks.)*

ZX80 software now half price

NEW! INVADERS for the VIC-20 colour computer £6-90
(no additional memory needed) cassette and instructions

Send s.a.e. for further info, detailing your computer, memory etc.

BRIDGE SOFTWARE (Y) **Mail order only**
36 FERNWOOD, MARPLE BRIDGE,
STOCKPORT, CHESHIRE SK6 5BE
Prices include VAT, post and packing in U.K.
European customers add 30p per item. Worldwide, 70p per item

ZX81 ZX81
JOIN
ZX-GUARANTEED

(Club is devoted exclusively to the ZX81 . . . and ZX82 when available)

All games/progs are guaranteed error free. ZX-guaranteed is not just games, it is intended to be educational to the user. Includes articles on BASIC, PEEK, POKE, MACHINE CODE, FLICKER FREE PROGRAMMING, HINTS & TIPS, etc. etc.

Membership is April to April. If joining late, all current year's back issues sent. Membership £5 per year. (Overseas £6.50. Outside Europe by air £10).

For sample back issue send £1 plus SAE

Send to: **G.A. BOBKER, 29 CHADDERTON DRIVE, UNSWORTH, BURY, LANCS. BL9 8NL**

Please enrol me as a member of ZX-GUARANTEED. I will complain like mad if errors found.

I enclose Cheque/P.O./Sterling draft for _____

NAME _____

ADDRESS _____

MICHAEL ORWIN'S ZX81 CASSETTES

CASSETTE ONE
for 1K ZX81

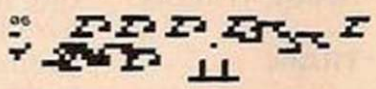
"I had your Invaders React cassette . . . I was delighted with this first cassette."
P. Rubython, London NW10

"I have been intending to write to you for some days to say how much I enjoy the games on 'Cassette One' which you supplied me with earlier this month. Please let . . . into the secret of your first time load every time!"
E.H., London SW4

Just two our of over 20 unsolicited testimonials.

INVADERS (1K)

PHANTOM ALIENS



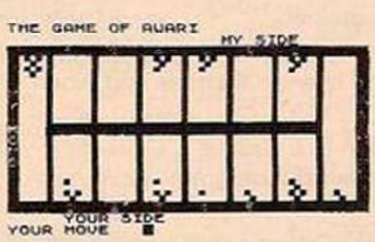
BUG SPLAT

Cassette One 1K machine code programs:
React, Invaders, Phantom Aliens, Maze of Death, Planet Lander, Bouncing Letters, Bug Splat.
1K Basic Programs:
I Ching, Mastermind, Robots, Basic Hangman.
PLUS Large screen versions of Invaders and Maze of Death, ready for when you get 16K.

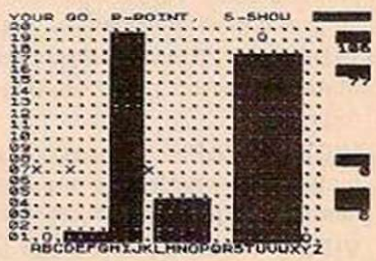
Cassette One costs £3.80.

CASSETTE TWO
Ten games in Basic for 16K ZX81

AWARI

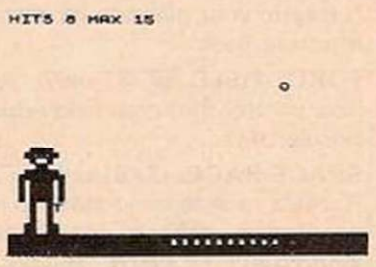


RECTANGLES



PONTOON

PENNY SHOOT



Cassette Two contains Othello, Awari, Laser Bases, Word Mastermind, Rectangles, Crash, Roulette, Pontoon, Penny Shoot and Gun Command.
Cassette Two costs £5.

Recorded on quality cassettes, sent by first class post, from:
Michael Orwin, 26 Brownlow Road, Willesden, London NW10 9QL. (Mail order only please)

ZX81 16K

MACHINE CODE DEBUG/MONITOR

- **ELIMINATE MACHINE CODE PROBLEMS** with ZX-MC — a new software debug/monitor for the ZX81 16K.
- **ENTER, RUN & DEBUG** your machine code programs independently of Basic commands. ZX-MC resides in RAM, and leaves you 12½K of memory to work with.
- **SAVE & LOAD AT DOUBLE SPEED** any specified area of free RAM. At last you are freed from storing your M/C in arrays or REM lines.
- **REGISTERS DISPLAY & BREAKPOINTS** to make de-bugging easier — PLUS many more useful commands.
- **A MUST FOR BEGINNERS & ADVANCED USERS** — concentrate on your M/C programs, not on how and where to store them.
- **ZX-MC** is supplied on a high quality cassette, with a 32 page operating manual, for only

£6.50 fully inclusive (C.W.O)

SCREEN KIT 1

A suite of machine code routines that are called from Basic programs, to enhance your screen display, and create Data Files on cassette. SCREEN KIT becomes part of your Basic program.

- **DRAW A BORDER**
- **CLEAR PART OF SCREEN**
- **LOAD ANY CHARACTER TO WHOLE SCREEN**
- **CLEAR SCREEN BY SCROLLING UP, DOWN, LEFT OR RIGHT**
- **KEYBOARD SCAN + FLASHING CURSOR**
- **INVERT VIDEO OF PART OF SCREEN**
- **MEMORY LEFT**
- **DATA FILES** — lets you Save & Load, at double speed, just the Basic variables. Different Data Files can now be Loaded into the same Basic program.
- Supplied on cassette with instructions.

£4.95 fully inclusive (C.W.O.)

Send large SAE for more details. Programs available mail order only. Allow up to 14 days delivery. Please make cheques/PO payable to:

PICTURESQUE

6 CORKSCREW HILL, WEST WICKHAM, KENT BR4 9BB

FREE Software Cassette

INSTANT INTERACTIVE GRAPHICS ON ZX81

LIGHT PEN SET for the RD 8100 **£49.50** (includes VAT & P&P)

- *DRAW complex graphics with ease on your TV screen and avoid tedious line by line programming.
- *Revise your display and SAVE on cassette, while your program runs.
- *Push pictures points and pixels with a poke of the Pen and a program PEEK. Try our VIDEO-TIDDLYWINKS!
- *MENU SELECTION — without keyboard entry.

The RD 8100 LIGHT PEN SET consists of the RD 8101 'MICRO-MUM' MOTHERBOARD, the RD 8180 LIGHT PEN with MODULE, and the RD 8100 SYSTEM MANUAL. Plug into your ZX81 — and LOAD, from the FREE RD 8100 SOFTWARE CASSETTE (1K and 16K), or write your own BASIC programs.
All orders are acknowledged, with a firm delivery date. Send just £49.50 (VAT and postal charges are included) to:

R D Laboratories

5 Kennedy Road, Dane End, Ware, Herts. SG12 0LU, (0920 84380)

For details of the Full RD 8100 SYSTEM of ZX81 interfaces, including Logic I/O, Analogue Input, Analogue Output, 8-Channel Analogue Multiplexer, Buffered Motherboard, send us a stamp.

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.

VIDEO-SKETCH. (ZX81 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.

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.

VIDEO-SKETCH

If you have an interest in graphics this is the program for you. It explores to the full the graphics capabilities of the ZX81 using a moving cursor to draw lines or to fix the position of keyboard entered text and graphics. Twelve full sized pages may be created and saved on cassette. Built in large alphabet for titles and headings. Option to copy pictures to ZX printer is provided.

NEWS FOR USERS

During the month of March our office will be open on Saturday mornings from 10.00 a.m. to 1.00 p.m. Come in and have a chat. You don't have to buy anything.

You can now buy our products over the counter at

Personal Computers,
20 Wellington Square,
Ayr KA7 1HB.

Buffer Micro Shop,
374A Streatham High Road,
London SW16.

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 (Plan + Ad)	—	—	17.95
PACK 2 (View + Graph)	—	—	13.95
GAMESET (Map + 5 Games)	—	—	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.

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.

Code	M/S/L	Qty.	Price	Total
P. & P.				

ORDER FORM

See above for codes

Your cheque no. .....

NAME.....

ADDRESS.....

.....

.....

SINCLAIR
ZX81 SOFTWARE

SERIOUS PROGRAMS (1-16K)
FOR THE MORE DISCERNING ENTHUSIAST!

CASSETTE 1

MATHS ONE (16K)
ATTENTION ALL PARENTS! Prompted by an article in practical computing (Jan 1981) on inferior maths software, we decided to produce a program that would give your child more than the boring reply: "Sorry you are wrong, try again!" Maths one will give your child sums in the normal way and actually show your child where he/she has gone wrong. EXAMPLE: (comp') 12 + 12 = ? (Child) 22, (Comp') Put down?, (Child) 1, etc. Both you and the computer are aware that the answer is wrong but the child is not and continues on to be shown his/her error/s when the sum is complete. Note: The whole sum is printed on the screen, with answers just as the child would do with pen and paper!

MATHSKATE (16K)
A fun game for the kiddies — each child chooses a rollerskater and is given a sum to complete. For each correct answer the skater moves faster and faster, but beware the sums become more difficult, until the winner is the child with the highest number of correct answers (and is naturally the first skater to the post).
Maths one + Mathskate...£3.50

CASSETTE 2

LANGUAGE TRANSLATOR (16K)
Having difficulty with foreign text? Then this is the program for you! Fast translation of one word, into its foreign equivalent in seconds. Or, if you prefer, the program will accept a paragraph which uses the top half of the screen with the bottom half reserved for the translation. Which will be a word for word translation from approx 700-800 words. All G.C.E. languages (in Roman text) available. Please state language choice.

WORD TEST
For the very junior members of the family — word test will give your child partially completed words and is then expected to complete the word. Second trys are allowed and the score out of ten with the correct answers are shown.
Language translator + Word test...£3.50

CASSETTE 3

BANK ACCOUNT (16K)
Why wait for a statement when you can have your own personal banking system! Accepts standing orders in the usual way and will tell you when your balance is below the free banking limit, then actually charge you for it! Just like the bank! Statements can be backdated and the computer periodically may ask you, when below free banking limit, whether you have ordered any cheques etc. If so your account will be updated accordingly. Current and deposit accounts for major banks available.

HOME BILLS READY RECKONER
Want to know if your electricity bill/telephone bill/net pay are correct? Then find out with ready reckoner so simple!
Bank account + ready reckoner...£3.50

PLEASE NOTE: Our software is of the very highest quality and stands to compare with the very best from the Sinclair stable and even if we might say so ourselves exceeds that standard.
No knowledge of computing required, just load and run!

Make cheques, PO, etc. payable to:

FUTURESOFT
38 PENSHURST ESTATE, PRINCE OF WALES ROAD, LONDON NW5.

SILVERSOFT

personal computer software

16K/ZX81 SOFTWARE
"STARTREK"

16K STARTREK: Exciting space adventure game, Klingons, Starbases, Phasors, etc.

"SUPER-WUMPUS"

16K SUPER-WOMPUS: Can you hunt and catch the mysterious Wompus? Intriguing underground adventure.

"GRAPHIC-GOLF"

16K GRAPHIC-GOLF: Test your golfing skills on Silversoft's 18-hole golf course, many hazards including lakes, streams, trees, etc.

"3D MYSTERY MAZE"

16K 3D MYSTERY MAZE: Amazing three-dimensional display! Fast machine code display, hundres of mazes.

"GAMES PACK 1"

16K GAMES PACK: Fantastic!! Value for money. Nearly 50K of programs on one cassette. (Five games, average program size 10K) including "Real-time, Graphic" Lunar Laner, Starwars, Hammurabi, Minefield, Mastermind.

Prices: £4.95 each cassette
£8.95 for any two

Send for s.a.e. for details.

Programs wanted — excellent royalties.

SILVERSOFT
40 Empress Avenue
Ilford, Essex
01-518 0877

CAMBRIDGE LEARNING
SELF-INSTRUCTION COURSES

A PRACTICAL DIGITAL ELECTRONIC KIT FOR ☆ LESS THAN £20 ☆

SUITABLE FOR BEGINNERS

Learn the wonders of digital electronics and see how quickly you are designing your own circuits. The kit contains: *seven LS TTL integrated circuits, breadboard, LEDs, and all the DIL switches, resistors, capacitors, and other components to build interesting digital circuits;* **plus** a very clear and thoroughly tested instruction manual (also available separately). All this comes in a pocket size plastic wallet for only £19-90p inc VAT and p&p. This course is for true beginners:

- needs no soldering iron.
- asks plenty of questions, but never leaves you stuck and helpless.
- teaches you about fault-finding, improvisation, and subsystem checking.
- the only extra you need is a 4½V battery (Ever Ready 1289, or similar), or a stabilised 5V power supply.

Using the same breadboard you may construct literally millions of different circuits.
This course teaches boolean logic, gating, R-S and J-K flipflops, shift registers, ripple counters, and half-adders. Look out for our supplementary kits which will demonstrate advanced arithmetic circuits, opto-electronics, 7-segment displays etc.

Other self-instruction courses from Cambridge Learning Ltd include:

COMPUTER PROGRAMMING IN BASIC	£10.50
DIGITAL COMPUTER LOGIC AND ELECTRONICS	£ 8.50
DESIGN OF DIGITAL SYSTEMS	£14.00

Please send for full details (see coupon below).

GUARANTEE No risk to you. If you are not completely satisfied, your money will be refunded upon return of the item in good condition within 28 days of receipt.

CAMBRIDGE LEARNING LIMITED, UNIT 82, RIVERMILL SITE, FREEPOST, ST. IVES, CAMBS, PE17 4BR, ENGLAND. TELEPHONE: ST. IVES (0480) 67446. VAT No. 313026022.

All prices include worldwide postage (airmail is extra - please ask for prepayment invoice). Giro A/c No 2789159.

Please allow 28 days for delivery in UK

Please send me:

.....SUPERKIT(S) @ £19.90

.....Free details of your other self-instruction courses.

I enclose a *cheque/PO payable to Cambridge Learning Ltd for £..... (*delete where applicable)

Please charge my:

*Access / American Express / Barclaycard / Diners Club Eurocard / Visa / Mastercharge / Trustcard

Expiry Date..... Credit Card No .....

Signature.....

Telephone orders from card holders accepted on 0480 67446
Overseas customers (including Eire) should send a bank draft in sterling drawn on a London bank, or quote credit card number.

Name.....

Address.....

.....

.....

Cambridge Learning Limited, Unit 82, Rivermill Site, FREEPOST, St. Ives, Huntingdon, Cambs, PE17 4BR, England. (Registered in England No. 1328762).

ZX81 ATOM VIC

Make the most of your microcomputer with our popular range of proven books:—

[ ] **GETTING ACQUAINTED WITH YOUR VIC 20,** by Tim Hartnell, with over 60 programs to get your VIC up and running from day one. **£5.95**

[ ] **GETTING ACQUAINTED WITH YOUR ACORN ATOM,** by Trevor Sharples and Tim Hartnell. 184 pages, 80 programs, including draughts. **£7.95**

[ ] **GETTING ACQUAINTED WITH YOUR ZX81,** by Tim Hartnell. Eighty plus programs in this 120-page book, including draughts. **£4.95**

[ ] **MASTERING MACHINE CODE ON YOUR ZX81 OR ZX80,** by Tony Baker. 180 pages, teaches machine code from first principles. **£5.95**

[ ] **THE GATEWAY GUIDE TO THE ZX81 AND ZX80,** by Mark Charlton. Over 60 programs and routines, ZX BASIC explained in detail. **£5.95**

[ ] **49 EXPLOSIVE GAMES FOR THE ZX81,** edited by Tim Hartnell. **£5.25**

[ ] **INTERFACE,** the monthly magazine published by the National ZX80 and ZX81 Users' Club, in conjunction with the Independent Atom Users' Group, is just £9.50 (UK), £12.50 (Europe) for 12 issues. **Sample copy,** with many programs for each machine, book, software and hardware reviews, education, contact addresses, **just £1.**

Please send me the items marked. I enclose £ .....

Name: .....

Address: .....

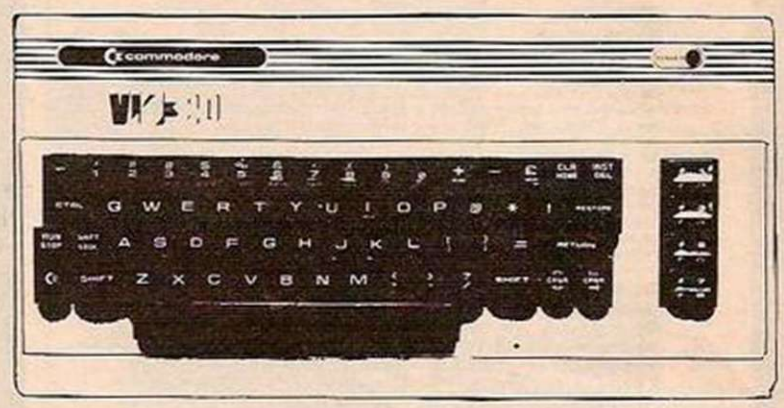
.....

.....

Postcode .....

Please make cheques payable to **INTERFACE** and send the above form, or a copy, to: **INTERFACE, Dept. YC/3**
44-46 Earls Court Road, London W8 6EJ

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
ADDRESS

72 Heath Road Twickenham Middlesex

Microgram Simulations ZX81

ZX81 - Video Genie - TRS/LII

Balance of Power As leader of a superpower you strive to maintain superiority of arms over a neighbouring country. The problem is that you and your enemy are mutually dependent on each other for raw materials. Can your economic, diplomatic and military judgements prevent a rapid slide towards nuclear war? Use threats, sanctions, force, tactical concessions, etc.

Tycoon Start a company producing "widgets" and compete in the market against a computer controlled rival. Start small and build up your business or borrow money and start big. You have to make decisions about financing, staffing, factory space, machinery and advertising, etc.

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 SE 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?

All programs 16K on quality cassettes (for 1 player).
Send £4.95 for 1/£8.90 any 2/£12.85:3/£16.80:4/£20.75:5

Please tell us which micro and send cheque/PO to:
73 The Broadway, Grantchester, Cambridge CB3 9NQ

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 -

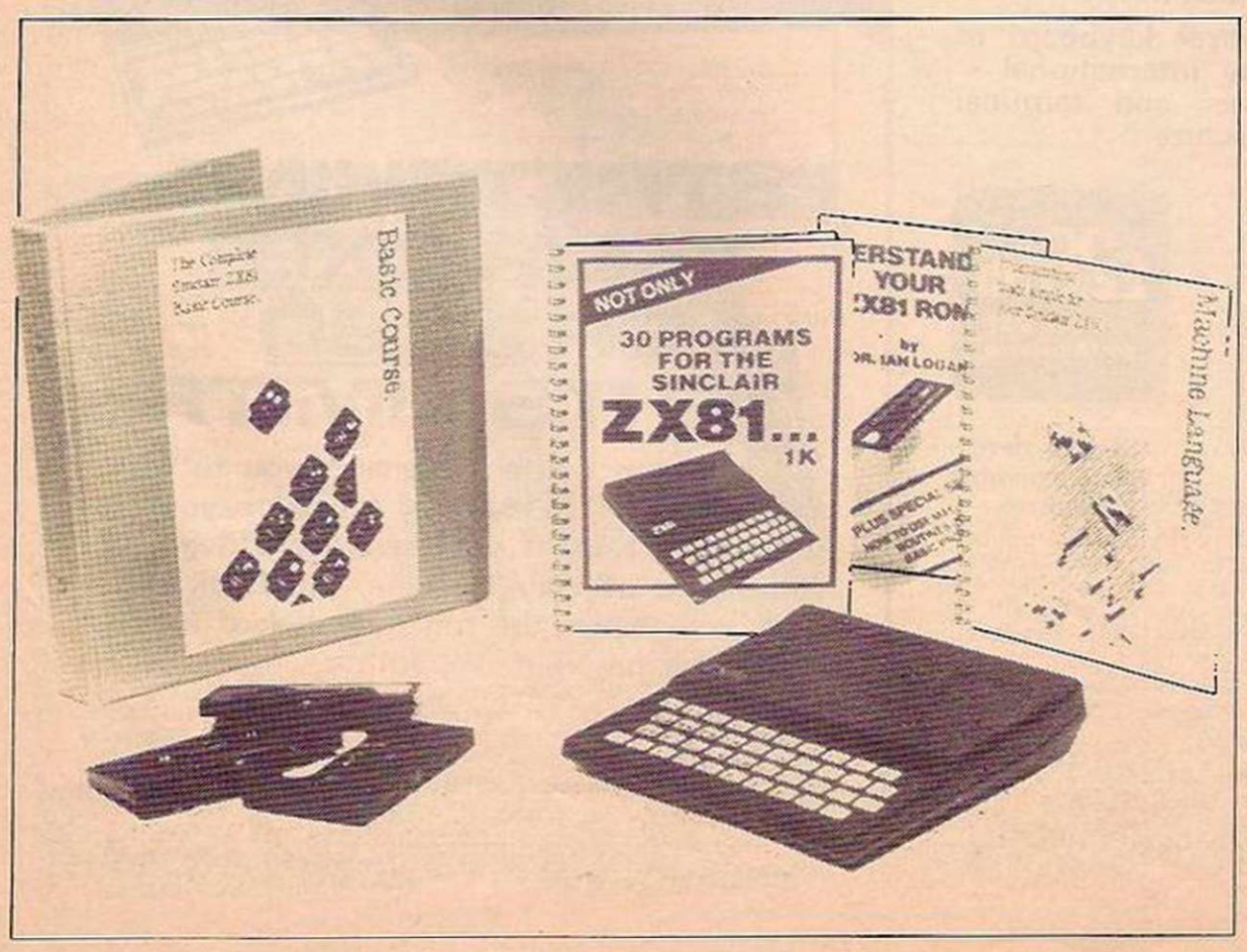
Not only over 30 programs, from arcade games to the final challenging Draughts playing program, which all fit into the unexpanded 1K Sinclair ZX 81 but also notes on how these programs were written and special tips! Great value!

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:.....

.....

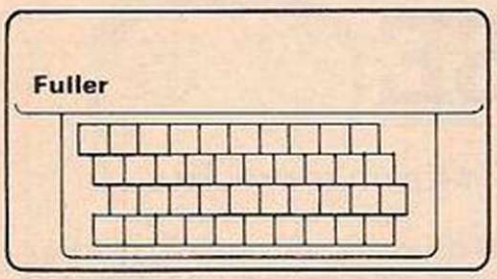
.....**Postcode**.....

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		£

FULLER FD SYSTEM FOR ZX80/81

THE MOST VERSATILE SYSTEM FOR EXPANDING YOUR ZX

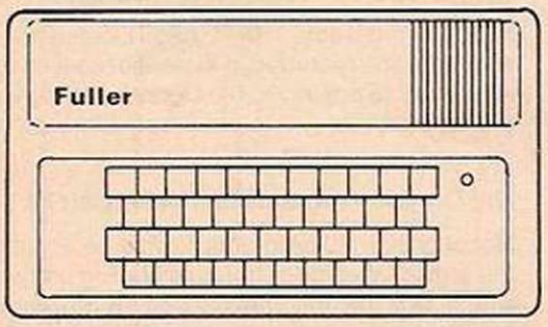
STANDARD KEYBOARD AND CASE



This splendid keyboard and case houses your ZX81 printed circuit board, which is simply screwed into place, the keyboard plugs into the ZX. You can now enter data with ease. The 40 key switch board is a custom unit not made up out of other manufacturers parts. The keytops are our own design and have the ZX Qwerty and functions foil printed onto them. Access to the user port, TV, MIC, and ear sockets are as per the ZX case.

Built keyboard and case £36.70 or £30.70 as a kit plus £2.10 postage and packing.

EXTENDED KEYBOARD AND CASE



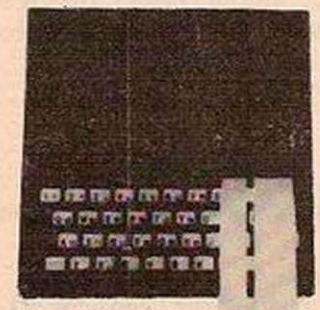
The case is designed to house not only the keyboard and ZX but also our motherboard, power supply, RAM cards and two other boards, not necessarily of our manufacture. The injection moulded case measures 200 mm x 350 mm x 60 mm and houses a 42 keyswitch board, the extra keys can be assigned to other functions. The case is supplied with a "Power On" LED.

Built keyboard and case £39.95 or kit £33.95 plus £2.50 postage and packing. Motherboards £15.95 plus 80p postage and packing. 16k RAM board £35.95. 64k RAM board £79.95.

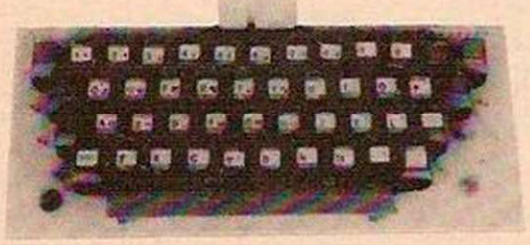
Keyboard Only Available!
Built £24.95
Kit £18.95 (+P.P. 80p)

Send SAE for details to:-
FULLER MICRO SYSTEMS, The ZX Centre,
Sweeting Street, Liverpool 2.

ADD A PROFESSIONAL KEYBOARD TO YOUR ZX 81



- No de-soldering necessary – just plug in.
- Full travel keyboard as used by international computer and terminal manufacturers.



£28.95 including VAT post & packing

"All-you-need" easy to assemble kit comprises:

One piece 47 key keyboard module fitted but not soldered to double-sided printed circuit board; connectors; simple plug-in flexible cables; screws, mounting feet and legends. Two-part keycaps with buttons pre-assembled on keyboard and clear protective clip-on caps for fitting after legends have been positioned. Comprehensive assembly instructions supplied with each kit. Allow 28 days for delivery.

Please send ..... keyboard kit(s) @ £28.95 each, cheque or postal order made payable to:- YC Feb
JK COMPUTER KEYBOARDS (dept.)
Glendale Park. Fernbank Road, Ascot, Berkshire.
Phone-a-Leaflet 03447 4731
Please ensure your name and address are clearly stated

STRETCHING YOUR ZX81 OR ZX80 TO ITS LIMITS

... has been written to enable you to get even more knowledge and fun from your ZX81 or ZX80. If you have a working knowledge of your machine, this book will help you realize the full potential of it and your own programming ability.

Only £6.95 from

DEPT. YC3, Computer Publications, Unit 3,
33 Woodthorpe Rd., Ashford, Middlesex TW15 2RP

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 01 690 7799. Visa, Access.

MEMORY PRICES — are Tumbling!!

It makes no sense to buy more than your current needs for your ZX81. Now you no longer need to!

ZX81

The Incremental 1.1 by East London Robotics is a unique memory expansion system for ZX81 for minimum outlay but giving you maximum flexibility.

* Fits inside ZX81 case leaving expansion port free.
* Childs play to fit — no soldering. Plugs into existing microprocessor socket and bolts to existing holes in ZX81 board for high rigidity/reliability.
* Expandable up to 16K in increments of 2K simply by plugging in memory chips.
* Does not stop there! On board start address selection (plug and socket) allows configuration alongside other memory systems (e.g. with Sinclair RAM pack giving from 18 to 32K contiguous RAM) thus placing absolutely no limits on your future memory expansion requirements.
* Ultra low power — incremental 1.1 with full complement of memory (16K).
* Starts you off at a price you can afford —
  Incremental 1.1 socketed for max of 8K — £8.50
  Incremental 1.1 socketed for max of 16K — £9.50
  Hitachi 6116 CMOS 2K byte memory chips — £5.85 each
  as at 6/12/81
* Money back guarantee — return intact within 14 days of receipt secures refund of price of goods less £1.00 handling charge.

All prices inclusive of VAT. Postage 50p for orders under £8.50.
S.A.E. for full spec or phone 01-471 3308
All cheques/postal orders to:

EAST LONDON ROBOTICS (Electronics),
'Finlandia House', 14 Darwell Close,
East Ham, London E6 4BT.

ACORN ATOM

ASTROBIRDS (5K* + 6K graphics)
Incredible GALAXIAN style program with fantastic sound effects! Screaming missiles, swooping bird-men. Undoubtedly the best game on the market. **£8.95**

LUNAR LANDER (5K* + 6K graphics)
Superb high res. version. Long range scan, short range scan. Limited fuel supplies. Land the module with minimum impact. **£8.95**

INVADER FORCE (5K* + 6K graphics)
4 Invader types + mother ship. Great sound effects. High score. 6 skill levels & increasing difficulty. **£8.95**

3D ASTEROIDS (3K* + 2K graphics)
Steer through the rolling, hurtling asteroids coming out of the black void. Exciting new graphical representation. **£6.95**

CHESS (12K) AT LAST!! M/C code + mode 3 graphics. Look ahead up to 8 moves. Offensive, Normal & 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**

SUPER RACE-TRACK (12K) Draw your own race-track & race against the clock, steering & accelerator controls. **£4.95**

DAMBUSTERS (3K + 2K gr) Realistic bombing raids, bouncing bombs, ack-ack etc. **£4.95**

ALIEN MAZE (5K + 2K gr) Escape the 3D labyrinth before the Alien tracks you down. **£5.95**

SPACE STORM (4K*) Survive amid the raging comets & space debris. **£4.95**

MARTIANS (12K + VIA) Use your force field to stop them landing. Beware the imposters. Needs quick reactions. **£7.95**

MAZE-BALL (12K) Very fast Ball-in-a-maze game with sound effects. Requires fast reactions. Timings & ratings given. **£4.95**

DEMON DUNGEON (5K*) Adventure game. Find the treasure in the depths of the dungeons. Beware the lurking demons whilst making your escape. **£6.95**

EXTRA MEMORY — Low power chips as recommended by Acorn 2 x 2114L — **£3.25**

WRITTEN ANY PROGRAMS? — WE PAY 20% ROYALTIES!

SPECIAL OFFER — Deduct £1 per cassette when ordering 2 or more.

(Free invaders program with 10K)

Please add 55p/order P & P + VAT @ 15%

Send Sae for FULL CATALOGUE.

PROGRAM POWER

Dept. Y.C.
5 Wensley Road,
Leeds LS7 2LX.
Tel: (0532) 683186

We welcome Access

BARCLAYCARD VISA

VIC GAMES

for the standard VIC 20

Challenging games of skill and initiative all in full colour and with great sound effects

ASTRO-DOCKER: Get the supply pods safely through to Scorpio's supply hatch. Progressive levels of difficulty.

PETALS-AROUND-THE-ROSE: So you think you're bright! Try and break this frustrating code in less than 100 attempts. As mind boggling as the cube.

MAZE OF DEATH: Can you guide your way through the maze avoiding monsters and collecting rewards? Watch out for the Hobgoblins!!

DEFENDER: Defend the planet's fuel elements against the marauding aliens using lasers and photon torpedos. Nine skill levels, time and score.

PROTECTOR AND SHIELDER: Use defence screens to ward off attacking missiles — how long can you hold out? Two games for the price of one.

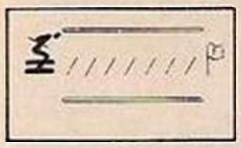
PRICES: £6.95 for each cassette or £12.95 for any two. Inc. P&P.
All programs produced on top quality cassettes.

ABACUS PROGRAMS
186 St. Helens Avenue, Swansea, W. Glam.
Tel: (0792) 50282

JRS SOFTWARE

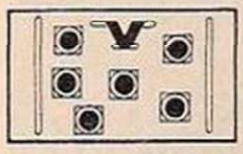
ZX80 ZX81

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



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 allow 14 days for delivery)
Full refund if 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).

ZX HARDWARE

Description of kit	*Kit Price*	*Built Price*
40 key full size keyboard for ZX81 (Built keyboard ready to plug in and go — NO soldering required)	£20.50	£25.75
Edge connector for kit		£1.95
Set of rubber feet for kit		24p
Case to hold keyboard (but not ZX81) (Built price includes keyboard fitted)	£10.30	£36.15
24 Line I/O port — controlled by BASIC (Can be used with a RAM pack and printer)	£16.95	£18.95
In/Out edge connector		£3.00
Motherboad with two connectors	£15.75	£18.50
Voltage regulator for motherboard (Built can be only ordered if built motherboard ordered)	£2.40	£3.00
Digital to analogue converter board	£16.95	£18.95
One digital to analogue buffer IC		£6.89
23 way male connector, single		£1.30
23 way male connector, double		£1.60
23 way connector for back of ZX81		£2.95
Books		
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
Cassette Tape for Real Applications book		£11.44

Send 10" × 7" SAE for free illustrated catalogue.
All prices included postage and VAT.

REDDITCH ELECTRONICS
21 Ferney Hill Avenue, Redditch, Worcs B97 4RU
Tel: Redditch (0527) 61240 (9am to 12.30, 1.30 to 5)

ARTIC COMPUTING

MOVING AHEAD WITH ZX SOFTWARE

ZX CHESS I reduced to £6.50
Very popular machine code program, with six levels of play and an analysis option. Unbeaten except by:

ZX CHESS II now only £12.99
A new improved version, with a faster response time, seven levels of play, and in addition a recommended move option.

ADVENTURES
Exciting machine code games with instant response, choose from the range below.

ADVENTURE 'A' £6.00. You find yourself stranded on an alien planet. Can you reach your ship and escape?

ADVENTURE 'B' £8.00. In a jungle clearing you come across an Inca temple. You must break in, collect treasure and escape alive. Beware. Includes a cassette save routine.

ADVENTURE 'C' £7.00. You are unfortunate enough to be drawn to an alien cruiser. Can you reach the control room and free yourself or will they get you first? Includes a cassette save routine.

GALAXY WARRIOR £3.00
Fast and exciting interactive animated graphics game. Hunt Clingons and go through black holes . . .

GALAXIANS £6.50
All the features of the arcade game in a fast machine code program, swooping attackers, explosions and personalised scoring.

1K GAMES PACK £6.00
and many more. For a catalogue giving full details, please send a s.a.e. to:

ARTIC COMPUTING
396 JAMES RECKITT AVENUE, HULL HU8 0JA

COMPUTER PARK 82

JULY 31 – AUGUST 6 1982

INTERESTING, FUN, EXCITING, EDUCATIONAL

INTEREST IN MICRO-COMPUTERS!

then

COMPUTER PARK '82

is the holiday for you. Join other computer enthusiasts for a week of fun and fascination with micros. Catering for all interests, we have assembled a wide range of computers and peripherals to create an exciting computer holiday. Experiment with:

ROBOTICS
SPEECH SYNTHESIS
PROGRAMMABLE RAILWAY LAYOUT
LIGHTING CONTROLLERS
GRAPHICS UNITS
ELECTRONIC MUSIC

Our excellent computing facilities are supplemented by a wide variety of other interesting indoor and outdoor activities. Suitable for all ages from 10 years upwards. Residential from 31 July to 6 August in a beautiful Northants country house.

For further details write to:

EDSOFT,
9 Little Oakley, Corby, Northants NN18 8HA

EDUCATIONAL COMPUTING on the ZX81

Suit children ages 5–11

No comparable collection offers so much for so little

THE LITTLE PROGRAMMES WHICH ARE BIG EDUCATORS

Here at last. A set of programmes to turn your Sinclair ZX81 into a powerful educational tool. And you don't even need to know programming. There are clear instructions and plenty of tips & advice. Designed to go beyond drill & practice the promote learning through interaction & discovery.

All programmes fit 1K

Creative use of graphics

Many innovative ideas

Fully documented

Includes many games

Educare's **50** 1K PROGRAMMES for PRIMARY EDUCATION

Includes:-

TORTOISE
A simplified version of the famous Turtle programme

CODED MISSILE
Combines the fun of arcade games with learning

£4.95 only incl. p & p

Graph-plotter ● Histogram ● Simon-spell ● Sketchboard ● Times-table ● Sets
Series-quiz ● XY-coordinates ● Count ● Equations ● Areas ● Guess-a-Volume
Angles ● Upstairs-Downstairs ● Music-notes ● See-saw ● Wipe-out ● Spell
Temperature ● Clock ● Money ● Snake
Mastermind ● Number-shoot ● + 26 more

EDUCARE

To: EDUCARE, 139a Sloane St., London SW1X 9AY

Please send me.....copies Educare's 50.
I enclose cheque/postal order for £.....
Name.....
Address.....
.....

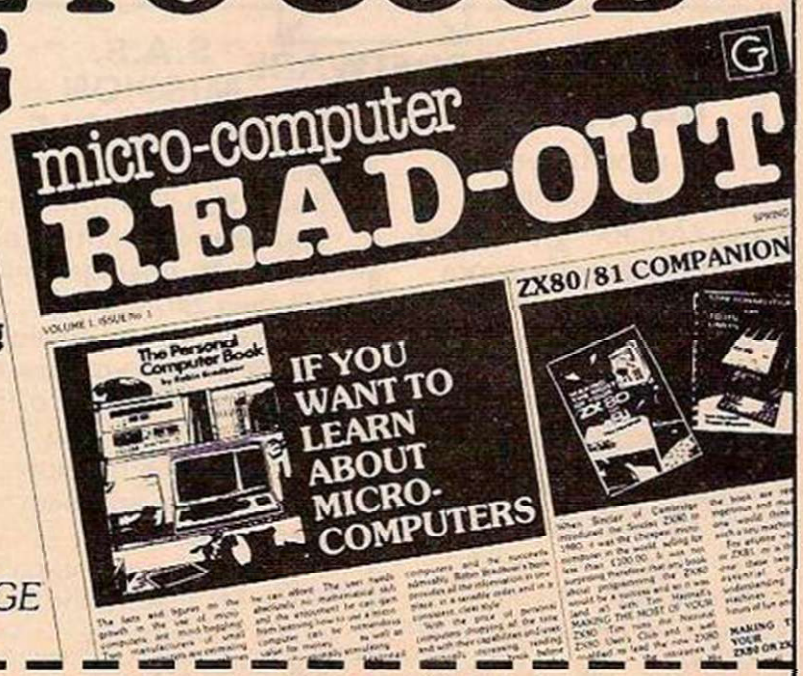
Let your child benefit early. Send now.

YOUR GUIDE TO GOOD COMPUTING BOOKS

If you are a user, a businessman, a student, a programmer or just beginning in microcomputing, then you should read MICROCOMPUTER READ-OUT

- NEWS • VIEWS • REVIEWS
- WHAT TO READ IN MICROCOMPUTING

SENT TO YOU—ABSOLUTELY ***FREE*** *OF CHARGE*



REGISTER FOR YOUR *FREE* COPY BELOW

To: MICROCOMPUTER READ-OUT
Gower Publishing Company Limited, Gower House, Croft Road, Aldershot, Hants. GU11 3HR

Please send me my FREE copy of MICROCOMPUTER READ-OUT
I am a microcomputer owner, model type: ☐ PET ☐ ZX 80/81 ☐ TRS-80 ☐ APPLE ☐ ATOM

☐ Other (please specify) _____ I am a: ☐ Student ☐ Hobbyist ☐ Businessman ☐ Professional computerist

Name _____

Address _____

_____

YC/MR/82

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.

THE BUFFER MICRO SHOP
(NEXT TO STREATHAM STATION)

NEW SOFTWARE SHOP EXCLUSIVELY FOR

ZX81

PROGRAMS, GAMES, "ADD-ONS"

MOST OF THE MAIL ORDER ITEMS ADVERTISED IN THIS MAGAZINE AVAILABLE OVER THE COUNTER

LOADING PROBLEMS? TRY OUR INTERFACE
BUSINESS & TECHNICAL DATA HANDLING PROGS;
PROPER KEYBOARDS; CONSOLES; VDUs

The BUFFER Micro Shop,
374a Streatham High Road,
London SW16
Tel: 01-274 6674

ZX81 1K + 16K STELLAR SUPER NEW SOFTWARE

SPACE 16K SOFTWARE BATTLE

Using superb dynamic flicker-free graphics, this 'Arcade' type game with continuous score display is instantly addictive. Destroying the Xylon fleet calls for swift reactions. Xylon battleships can deflect your photon torpedoes; you must escape into hyperspace to avoid destruction. If you succeed, the action resumes. Can you beat the highest score?

S.A.S. MISSION IMPOSSIBLE

As a member of the crack S.A.S. hit team you have 3 minutes to rescue 10 hostages and kill their terrorist captors. Bombs explode about you as you blast your way through to the diplomats. Can you complete the mission successfully and beat the fastest time? This exciting game calls for swift action and quick thinking to succeed. No two missions are alike.

NEW 1K SOFTWARE

GRAPHIC — move to any part of screen and draw in text or graphics from a painting palate of your choice.
U.F.O. INVADER — Guide your missile to its target via the keyboard.
MASTERMIND — full screen display of this popular game.
RADAR SCAN — can you recall how many battleships or submarines have been spotted as the speed increases.
16K games cassette £4.95 inc. p&p
1K games cassette £3.95 inc. p&p

Make cheques payable to:

STELLAR SOFTWARE
144 Pampisford Rd., South Croydon, Surrey CR2 6DA

LOAD AND SAVE PROGRAMS FASTER AND MORE RELIABLY WITH THE

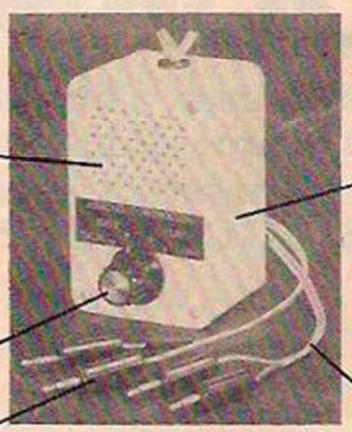
ABACUS CONTROLLER

A MUST FOR CASSETTE BASED MICROCOMPUTER SYSTEMS — ZX80/81, ACORN ATOM and APPLE

•BUILT IN MICROPHONE/ SPEAKER:
Allows you to name programs before saving and cue up programs accurately ready for loading.

•SINGLE SWITCH OPERATION:
Load and save programs simply by selecting position on switch. Eliminates hum caused by leaving both jack plugs in cassette recorder.

•PLUG IN CONNECTIONS:
Supplied ready to use, just plug into computer and cassette recorder — no need to remove plugs again. *Connections supplied to suit your computer.*



•SMART COMPACT CASE:
White A.B.S. housing measuring 100×65×50mm.

TRS 80 OWNERS
Your controller incorporates a cassette motor. Overide switch.
Price: £13.95.

•SIMPLE EASY TO FOLLOW INSTRUCTIONS:
Connect up the controller in seconds — learn to use in minutes.

•70 CENTIMETRES OF CABLE:
Allows you to site cassette recorder conveniently.

Send Cheque or P.O. for £12.00 including P&P to:

ABACUS ELECTRONICS
186, St Helens Avenue
Swansea, West Glam.
Tel: (0792) 50282

A & F SOFTWARE

G0104 CYLON ATTACK: Intercept the invading Cylon fleet: Fast moving 3D action: Constant instruments displayed includes—Long range scanner—Fuel & Laser energy. Features: Score-High Score & Full Sound Effects 5K Text 6K Graphics £4.95

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 test ½K graphics £3.95

D0100 POLE/EARLY WARNING £8.50

D0105 MINEFIELD/TANGLED £7.50

D0106 POLECAT/EARLY WARNING/MINEFIELD £10.00

D0111 CYLON ATTACK/EARLY WARNING/POLECAT £10.00

SPECIAL OFFER Any 4 games only £12.00

T0101 Pack of 10 Personal Computing Cassettes (C30) £7.95

We pay 25% royalties on your programs — phone for details

NOW AVAILABLE FOR UK101/SUPERBOARDS
2K RAM BASIC TOOLKIT

This toolkit adds nine new basic words for you to use. The tape loads from basic with or without another program present. It loads directly into the top 2K of Ram independent of the ram size and features its own boundaries.

FEATURES: Fast load in under 2 mins, compatible with all popular monitors and basics.*

NEW COMMANDS: Auto, help, find, dump, step, trace, off, delete and renumber.

EXCELLENT VALUE AT £7.95

*Disables Basic 5 commands (Please state machine/monitor when ordering)

ORDERS TO: **A & F SOFTWARE, 10 WILPSHIRE AVENUE, LONGSIGHT, MANCHESTER M1Z 5TL.**
24 HOUR TELEPHONE ORDERS ON (061) 248 7195
Orders normally dispatched within 72 hours
Please enclose a SAE with enquiries
Co. Reg. No. 2771093

ATOM USERS!

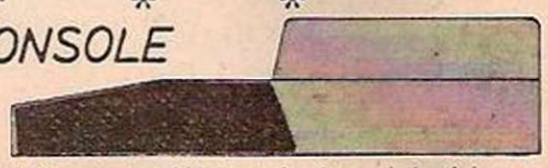
ADPROM 4000 UNIT

for adding on EPROMS as required. Can be used on other computors with 24 pin EPROM sockets (e.g. ZX 80). . . . . £32 (excl. vat & p.p.)

WANTED!! Elegant programs for our EPROM and TAPE library service.
Details on request with brochure.

* * *

ATOM CONSOLE CASE



Case only . . . . £25 (excl. vat & p.p.)

Polished teak veneered sides, textured black stelvetite and aluminium chassis. Plenty of room inside for RAM Expansion (units available from us), power supplies etc., and T.V. on top. Available as case only, or with integral RAM expansion unit, and/or integral ADPROM 4000.

* * *

CASES FOR YOUR OWN PROJECTS

Low priced QUALITY cases–STRONG enough for the workshop–ATTRACTIVE enough for the home.

Matt black plastic end cheeks, textured Stelvetite body . . from £6·25
Teak veneered end cheeks, Aluminium & Stelvetite body . . from £7·88
(excl. vat & p.p.)

* * *

FOR BROCHURE & PRICE LIST SEND A5 SAE TO

ELINCA LTD., LYON WORKS, CAPEL ST., SHEFFIELD S6 2HL

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

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. Move the cursor up, down or sideways to the desired row and column then enter a new figure or formula and everything on the worksheet dependant on it changes automatically.

Features include selectable format, "slow" mode for smooth scrolling across grid, single key cursor and grid control, capacity for over 2000 numbers (should you ever need that many!), very fast computation of results, ability to work with ZX printer, and operational procedure designed for convenience and speed in use.

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 cassette and full documentation send cheque or P.O. for £7.95 to: **Silicon Tricks, Dept. C2, 2-4 Chichester Rents, Chancery Lane, London WC2.**

Silicon Tricks

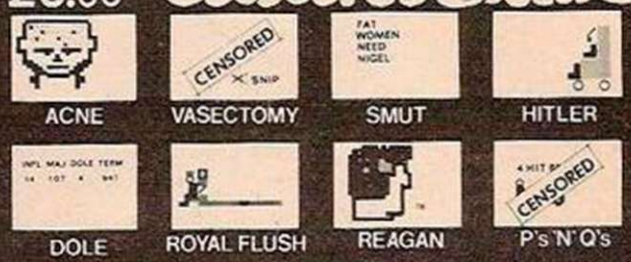
ZX HOTLINE — 01-603 6074
Ring for details of Computercalc ZX, half price paper for the ZX printer and our royalties scheme for programmers

1K ZX81 ADULT GAMES

FOR JADED MINDS. BAD TASTE IS OUR SPECIALITY

cassette No. 1 for the over 16's
£3.00

CAN OF WORMS



cassette No. 2 for the over 18's
£5.00

LOVE AND DEATH

cassette No.3 for the over 16's
£5.00

THE BIBLE

prices include bizarre audio intros, revoltingly descriptive instructions, postage & package
send to: AUTOMATA LTD., (Dept.Y), 65A Osborne Road, Portsmouth PO5 3LR, Hants.

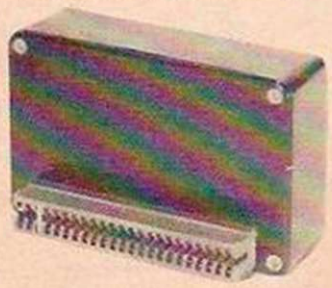
ZX81 HEWSON CONSULTANTS ZX81

HINTS & TIPS for the ZX81 **£4.25**
by ANDREW HEWSON

"Good value and quite fascinating . . . a very inexpensive way of acquiring months of programming experience" *Your Computer* Nov 1981
"Excellent . . . very good value for money" SYNC

80 pages explaining how to squeeze a computing quart out of a Sinclair pint pot.
Saving Space — vital reading for all ZX81 users.
Understanding the Display File — using the display file as memory, clearing a part of the display, using tockens in PRINT statements. Covnerting ZX80 programs — explaining simply but comprehensively how to convert the hundreds of published ZX80 programs. Chaining programs — revealing techniques for passing data between programs, calling subroutines from cassette and establishing data files. Machine Code Programs — all you want to know about Z80 machine language. Explaining how to write, load, edit and save machine code and how to debug your routines. Routines and programs are scattered liberally throughout the text and the final chapter consists of 12 useful, interesting and entertaining programs such as LINE RENUMBER, BOUNCER, SHOOT, STATISTICS, etc.

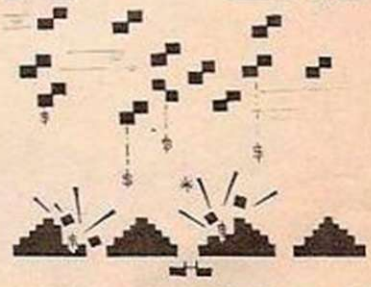
16K RAM **£37.50**
A top-quality add-on memory, simply plugs into the back of your Sinclair computer. Can be used in conjunction with the ZX printer. Neatly packaged in a black plastic shell to match your ZX81. **SPECIAL OFFER** FREE copy of our super SPACE INTRUDERS cassette with any order for the 16K Ram Pack received by 12th March 1982. One copy per customer.



64K MEMORY **£79.00**
Developed by Memotech this amazing 64K RAM needs NO extra power supply. Simply plugs neatly and firmly into the rear port of your ZX81. Can be used with the ZX printer and other add-on hardware. Just look at these features . . .
*8-16K can be switched in and out in 4K blocks to leave space for memory mapping.
*12-16K can be protected against overwriting during loading from cassette.
*directly addressable and user transpartent.
*up to 15K of basic program.
*32K or more of variable area.

Z80 OP CODES **£1.45**
A must for the beginner and the experienced programmer alike. This handy ready reckoner lists all the 600 plus Z80 machine code instructions in decimal and hexadecimal with their mnemonics. Each Op Code is succinctly explained and cross-referenced. Supplied in a protective transparent wallet for easy reference and durability.

16K SOFTWARE



SPACE INTRUDERS **£4.95**
Not to be missed. All action display. 40 alien ships in each squadron. Automatic option — the machine plays itself. Squadron after squadron of aliens attack your position. Three laser guns. Full score display. Written in machine code for super fast fun.

PROGRAMMERS TOOLKIT **£6.50**
Are you writing your own programs for your ZX81? Then use our TOOLKIT to do the donkey work. Copy into RAM before you start work and then you will have it at your fingertips. Comprehensive LINE RENUMBER including GOSUBS and GOTOS; LOAD, EDIT and RUN machine code programs; INSPECT the ZX81 system routines; COPY them into RAM and PATCH and/or EXTEND them; FIND a given piece of BASIC code and replace all occurrences of it; move blocks of Basic lines with EDIT.

LANGUAGE DICTIONARY **£3.75**
Now you can construct your own English/French, English/Anything dictionary with our LANGUAGE DICTIONARY. UPDATE the entries, SEARCH for a word, CREATE a new dictionary and save it on tape.

1K SOFTWARE

MINI INTRUDERS for the 1K machine **£3.95**
An incredibly fast moving game, dodge left and right to avoid falling missiles. Fire Salvo after Salvo at the attacking alien squadron, more aliens join the squadron all the time. Count how many lazer bases you lose before you have cut them down.

PLANET LANDER **£3.75**
Four programs:
i) Planet Lander; ii) Space Docking; iii) Stopwatch; iv) Clock.

STATISTICS **£3.75**
Three programs:
(1) (I) Statistics; prints the current mean and standard deviation after each value is entered. (II) Regression; prints the current mean and standard deviation of the y values, the x values and the intercept and slope of the regression line. (III) Trend; prints the current mean and standard deviation of the y values; the x values and the intercept and slope of the trend line.
(2) Chi square test calculates the value of the chi square statistic for comparing observed and expected values.
(3) Graph plot; plots a graph of data entered from the keyboard.

Cheque with order or quote access number to:
HEWSON CONSULTANTS, Dept. YC, 7 Grahame Close, Blewbury, Oxon OX11 9EQ. Tel: (0235) 850075

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 is 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

£13.99 ASSEMBLED

50p Post + Packing + Add 15% VAT

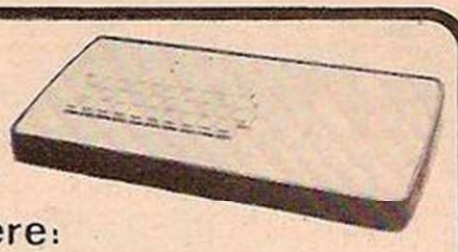
Snap on Analogue card and Relay board available shortly. Send SAE and 35p for details.

VISA

THURNALL (ELECTRONICS) ENG.
DEPT Y, 95 LIVERPOOL ROAD,
CADISHEAD, MANCHESTER M30 5BG
TEL: 061-775 4461 (24 hour)

ZX81 owners

Protos
Keyboard is here:



At last! A *real,* full size keyboard in a top quality case for your ZX-81.

Simply unscrew your ZX-81 printed circuit board from its black Sinclair case and plug into Protos.

FULLY BUILT £64.95 inc. VAT

- More accurate, faster typing with bigger and *real* keys
- 40 colour coded key-tops for easy reading
- Robust, 'big' computer construction
- PCB prepared for more add-ons to come
- New edge connector provided for Sinclair and other manufacturers' peripherals
- Key legends can be changed for future new ROM functions
- Sinclair PCB fully enclosed — and room for much more

If you feel you've outgrown your ZX-81 don't sell it for peanuts and move to another system. Add it to Protos and make your ZX-81 grow.

For details, large SAE, please. For orders add £2.50 post and packing. Cheques to 'Frome Computing'.

Protos Computer Systems

Frome Computing,
20 Ashtree Road, Frome, Somerset, BA11 2SF

LOOK! . . . it's here . . .

"ZX81 LABYRINTH"
THE 3-D MAZE GAME FOR 16K

. . . a sell-out at the ZX Microfair and now sold by leading computer shops . . . now direct by mail order.

* **YOU SELECT THE MAZE SIZE YOU WANT**
* **A DIFFERENT MAZE EVERY TIME!**
* **FULL MAZE PLAN SHOWN, THEN MOVE KEYS**
* **PASSAGES SHOWN IN 3-D EFFECT**
* **FAST (M/ C CODE) MOVES**
* **LOST! DON'T PANIC, HELP ALWAYS AVAILABLE**
* **OCCUPIES ALMOST 14K — YES 14K**
* **FULL ACTION REPLAY — RE-LIVE EVERY STEP**

. . . You'll be surprised!

Cassette, full instruction, load tips .....only £5.95

ALSO . . . FOR **1K "ZX81 BUMPER 7"** 7 PROGS:

*** REPEAT 20 * SKI SLALOM * PAPER, STONE, KNIFE ***
*** SNOWFLAKE * PATTERNS * BANCO * SKETCH ***

. . . all carefully designed to be FUN and illustrate ZX81 features such as 'scroll'.

Cassette, instructions, load tips .....only £4.95

AXIS 1981 — SOFTWARE FOR MICROS

TO:
AXIS (YC1), 71 BROOKFIELDL AVE., LOUGHBOROUGH, LEICS LE11 3LN

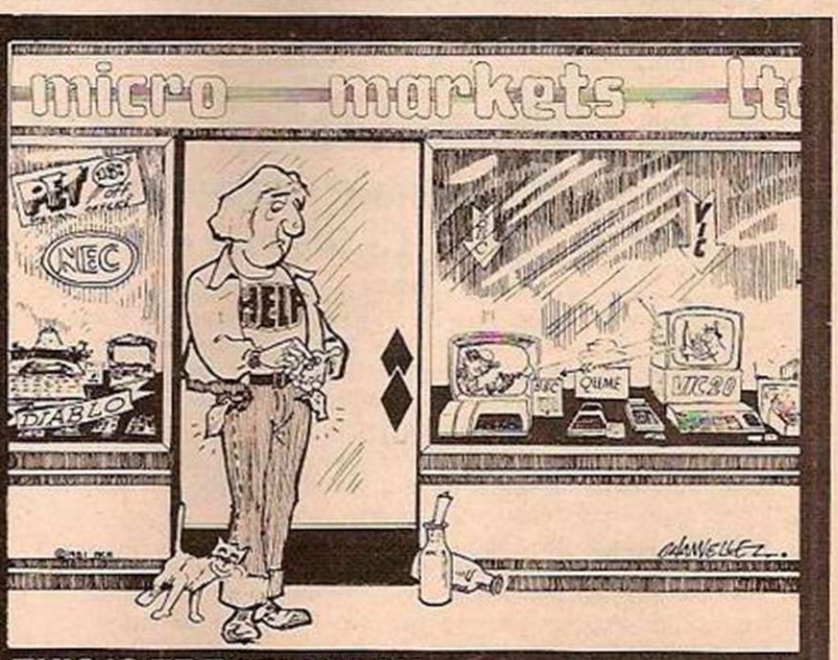
I enclose cheque/PO for .....payable to AXIS.

Please send ☐ "ZX81 LABYRINTH" ☐ "ZX81 BUMPER 7" to:

Name ..... Date .....

Address.....

.....



THIS IS FRED McNASH
WHO HAS NO CASH
HE CAN'T COMPUTE
WITHOUT SOME LOOT
WITH THINGS SO EXPENSIVE
HE FEELS VERY PENSIVE
BUT DON'T BE SAD
IT'S NOT THAT BAD
WE'VE MANY PERMS
OF EASY TERMS
APPLY FOR QUOTATION
FOR YOUR EDIFICATION

COMMODORE APPLE
ATARI VIC TEXAS
BBC? SHARP NEC
SUPERBRAIN OKI
TELEVIDEO ACORN
HEWLETT PACKARD
TEAC SIEMENS
NOT HERE JUST ASK
INTEGREX PERTEC
EPSON CENTRONICS
OKIMICROLINE QUME
OLYMPIA HONEYWELL
NEC SPINWRITER
P TIGER DIABLO
KEITHLEY HITACHI
SHORT&LONG RENTAL
PERSONAL LOAN
HIRE PURCHASE
LEASING

Avon Computer Rentals
FREEPOST 1 THORNBURY BRISTOL BS12 1BR
TELEPHONE (0454) 415460

MICRO-80

UK Subscription Dept.
24 Woodhill Park Pembury Tunbridge Wells Kent TN2 4NW

WE ARE PLEASED TO ANNOUNCE that MICRO-80 is now available in the UK in CASSETTE EDITION.
Each month we publish at least six programs for the TRS-80 or VIDEO GENIE and . . .
SUBSCRIBERS may now have the benefit of receiving their programs on cassette for IMMEDIATE LOADING.
WE ARE ALSO CONTINUING our special offer of a FREE cassette program to all new subscribers who complete the coupon below — even if you order a subscription to the magazine only.

Please enrol me for an annual subscription and send me my FREE cassette program.
I enclose £16.00 ☐ (magazine only) or £43.60 ☐ (magazine and cassette edition).
(enclose your cheque/P.O. made payable to MICRO-80 and send to the above address)
Software offer, and cassette edition prices applies to U.K. residents only. Overseas subscription rates on application.

Name .....
BLOCK CAPITALS PLEASE

Address .....

.....

YC 3/82

ZX81 with 16K RAM-PACK

6 GAMES ON CASSETTE FOR ONLY £3.50 (Post free)

Not one, not two, but SIX exciting games on one high-quality cassette, ready to load on your ZX81 with add-on 16K RAM pack. Easy to operate, fun to play! Hours of entertainment for all the family! Comes with full documentation, games descriptions and easy-to-follow loading instructions.

- **THE MONSTERS OF DRARGOOL** Enter the underground labyrinth of Drargool at your peril. Risk death fighting the many weird and fierce monsters in your search for treasure. Only the luckiest get their treasure out alive!
- **SNAIL RACE** Back the snail you fancy in each of four races — unless you lose your shirt first! Constant on-screen display reminds you how much cash you've got, which snail you backed and at what odds (which vary from race to race and game to game).
- **GUNFIGHT** Shoot it out across a canyon with three desperadoes. Get them all before they get you!
- **ROULETTE** For two players against the ZX81. The classic casino game, with eight different betting options and simulated wheel-spin.
- **BATTLESHIPS** The schoolboy game brought up to date. How good a naval gunner will you be?
- **ONE-ARMED BANDIT** Your own "fruit machine" on the TV screen. "Hold" facility and constantly-updated screen display of your progress.

All the above games have informative and attractive screen displays with none of the unpleasant "screen-flashing" that spoils some other ZX81 games. Get your cassette of six games today!

SEND TODAY! MONEY BACK IF NOT DELIGHTED!
Price includes cassette, library case, inlay, documentation and postage. Send £3.50 cash/PO/cheque to:

MOVIEDROME VIDEO (YC1)
19 Leighton Avenue, Pinner HA5 3BW

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 textra 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 X$; 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.

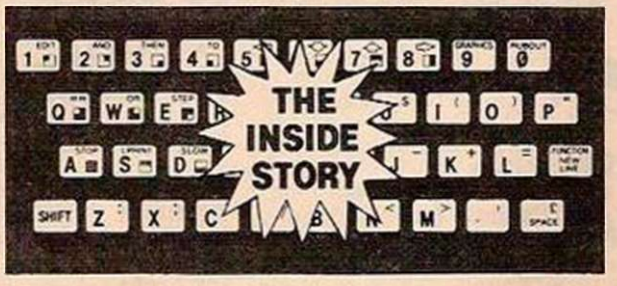
All products fully guaranteed. Fully inclusive prices are as follows:
QS DEFENDER £5.50/QS ASTEROIDS £5.50/QS CHRS DEMO (separately) £3.50
QS MOTHER BD. £12.00/QS CONNECTOR £4.00/QS SOUND BD. £26.00
QS CHRS BD. £26.00/QS 3K RAM £18.00/QS HI-RES £85.00
Cheques should be made payable to "Quicksilva" and 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

"OUTSTANDINGLY USEFUL"

THE ZX81 COMPANION



Bob Maunder

LINSAC

Price £7.95 incl. UK postage
ISBN 0 907211 01 1

THE ZX81 COMPANION was reviewed in the September 1981 issue of the Educational ZX80/81 Users' Group Newsletter as follows:

Bob Maunder's ZX80 Companion was rightly recognised to be one of the best books published on progressive use of Sinclair's first micro. This is likely to gain a similar reputation. In its 130 pages, its author does not go as far as he did before, but his attempt to show meaningful uses of the machine is brilliantly successful.

The book has four sections, with the author exploring in turn interactive graphics (gaming), information retrieval, educational computing, and the ZX81 monitor. In each case the exploration is thoughtfully written, detailed, and illustrated with meaningful programs. The educational section is the same — Bob Maunder is a teacher — and here we find sensible ideas, tips, warnings and programs too. The monitor listing (0000 to 0CB9), while unique, is less fully backed up, and will be of no use to the ZX81 beginner without some knowledge of Z-80 assembly.

To conclude — this book is definitely an outstandingly useful second step for the ZX81 user.

Send cheques for £7.95 to:

LINSAC (YC)

68 BARKER ROAD, LINTHORPE,
MIDDLESBROUGH TS5 5ES

LASERBUG

London And South East Region BBC Users Group

Whether you are a BBC Microcomputer owner, have limited access or are merely interested, then **LASERBUG** has something to offer you.

LASERBUG is an independent users group dedicated to the support and enhancement of the BBC Microcomputer..

LASERBUG is a central point for ideas and information — we want to hear from you and pass on your ideas and discoveries. Write to us at the address below — but please enclose a SAE if you want a reply.

LASERBUG newsletter is distributed to members each month and is full of news, reviews, letters, articles, programs, contacts and classifieds (rates on application). Our regular meetings also go a long way to help you get the best out of your BBC Microcomputer.

You want to join? For £12.00 you get a year's subscription to **LASERBUG**, 12 issues of the newsletter and free entry to all **LASERBUG's** meetings and shows — or send £1 and a large SAE for a sample copy of the **LASERBUG** newsletter and all the latest information.

Write to:

LASERBUG
Box No 100, Your Computer, Quadrant House
The Quadrant, Sutton, Surrey.

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

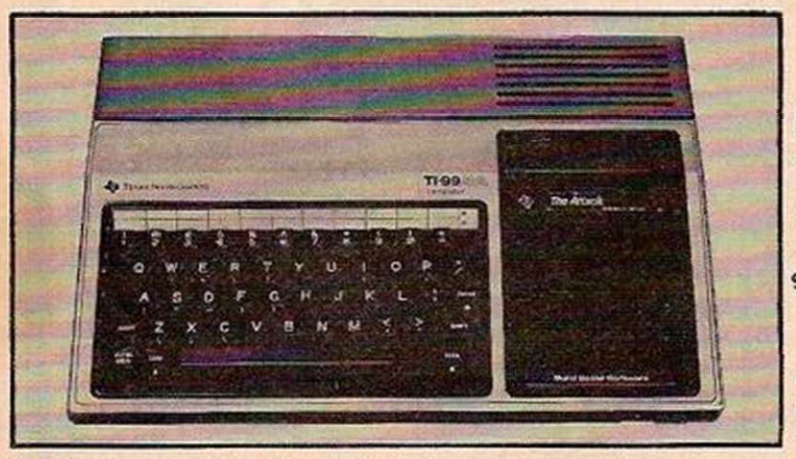
MONITORS
- BMC 12" green phosphor — 18MHz

Price **£175** × 15% VAT (carriage paid)

6 Laleham Avenue, Mill Hill,
London NW7 3HL
Tel: 01-959 0106

adda home computers

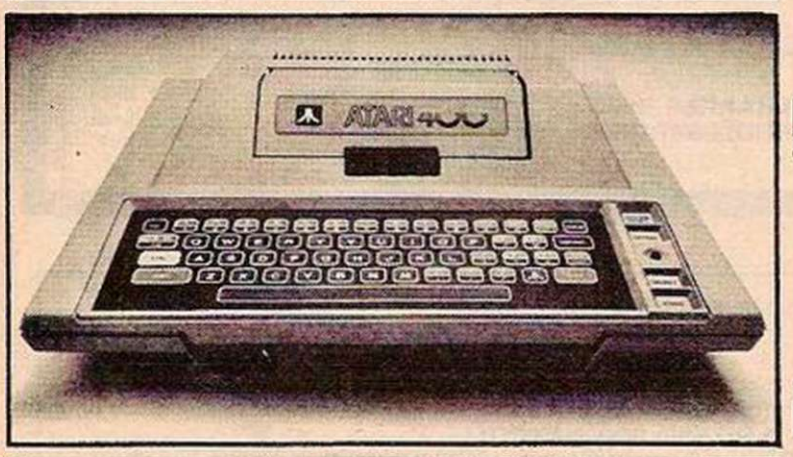
Now introduce to their range the new Atari and Texas Instruments home computers



TEXAS INSTRUMENTS TI-994A £299.95

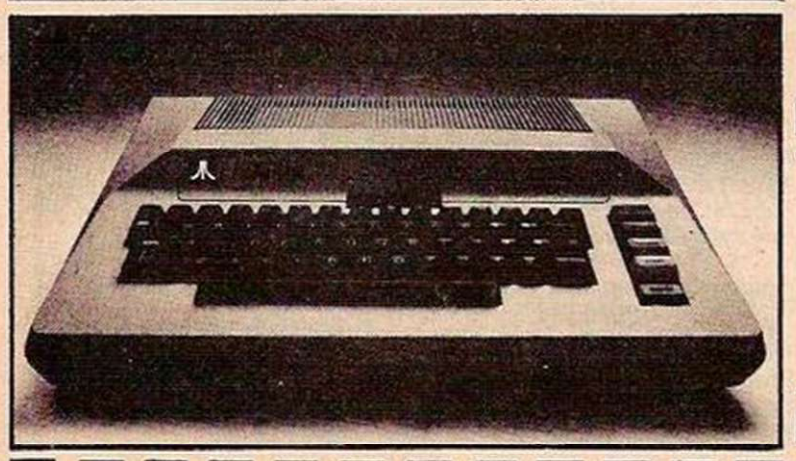
SPEECH SYNTHESISER £99.00
SPEECH EDITOR MODULE £39.95

- ★ 16K Ram (expandable to 48K)
- ★ 26K Rom (including BASIC)
- ★ High resolution graphics (192 x 256)
- ★ 16 colours (foreground middle & background)
- ★ Full memory mapped screen
- ★ Sound—3 simultaneous tones and white noise generator
- ★ Sound through own domestic colour T.V.
- ★ Interface to two cassette players



ATARI 400 (16K RAM) £345.00

- ★ Full qwerty keyboard (touch type on 400)—and four function keys
- ★ Full screen editing and 4-way cursor control
- ★ 40 character x 24 line display
- ★ Display has upper & lower case characters, double & quad size text & inverse video
- ★ Background, plotting, border & text, colours all setable to any one of 16 colours
- ★ Four joystick/paddle ports, sound output through domestic colour T.V.
- ★ Basic cartridge & 10K Rom operating system
- ★ Comprehensive documentation



ATARI 800 (16K RAM) £645.00

HARDWARE & ACCESSORIES	
RS 232 INTERFACE	£149.00
DISK CONTROLLER	£199.00
DISK DRIVE	£399.00
THERMAL PRINTER	£269.00
THERMAL PAPER for 2 rolls	£4.95
WIRED REMOTE CONTROL (JOYSTICKS)	£29.95
PLUG-IN RAM EXPANSION (ADDITIONAL 32K)	£299.00
CASSETTE CABLE	£9·95

HARDWARE & ACCESSORIES	
ATARI 410 CASSETTE RECORDER	£50.00
810 DISK DRIVE	£345.00
822 THERMAL PRINTER (40 COL)	£265.00
RS232 INTERFACE	£135.00
JOYSTICKS	£12·95
PADDLES	£12·95

Full range of software covering areas of:—games, education, finance (home & business).

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: _____

_____

MAIL ORDER to: Adda Home Computers Ltd. FREEPOST, London W3 6BR 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 Home 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:.....

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).

Sinclair ZX81
* NEW RELEASES *

Access

BARCLAYCARD VISA

DICTATOR

Another great adventure game from Bug-byte for the 16K ZX81. This time, you are the President of a small state. The object of the game is to avoid revolution, escape from assassination attempts, and maintain your popularity, while managing the secret police and army, and maintaining a secure economy. This is a very complex simulation, utilising the whole 16K, and the cassette comes with an eight page booklet giving full instructions and hints on how to survive. Can you stand up to the pressures of life as a dictator and prevent unrest from spreading? Place an order today and find out.

Price £9.00

CONSTELLATION

Turn your ZX81 into a telescope! The program will produce a simulation of the night sky as seen from any chosen position on Earth at any chosen time this century. You can point your "telescope" in any chosen direction, move it up, down left or right; zoom in or pull out and display the stars by magnitude or constellation.

Price £8.00

VIC-20 software now available

VICMEN

Fantastic arcade-type game for the unexpanded VIC based on the popular "Puckman" game. Makes full use of the VIC's colour, sound and graphics capabilities. Written completely in machine-code.
SUPPLIED ON CASSETTE FOR ONLY £7.00 inclusive.

RENUM

Complete renumbering program for the ZX81. Renumbers line numbers, GOTOs and GOSUBs. Very fast. A must for the serious programmer.

Price £4.00

ALL OUR PRICES INCLUDE VAT & POSTAGE
Access and Barclaycard orders accepted on
051 227 2642 (24 hour service)

BUG-BYTE SOFTWARE

98-100 THE ALBANY
OLD HALL STREET
LIVERPOOL L3 9EP

Acorn Atom

NEW Galaxian

We've done it again!

Yet another fantastic arcade game from the leading suppliers of Atom software, this time based on the popular "Galaxians" game. Fast-moving, high-resolution (graphics mode 4) aliens combine with realistic sound effectgs to make this one of the best Atom games available. All the usual features — swooping aliens, three lives, high-score etc. Can you get through six fleets of aliens, each level becoming more difficult?
The game is supplied on cassette for the 12K Atom.

£8.00

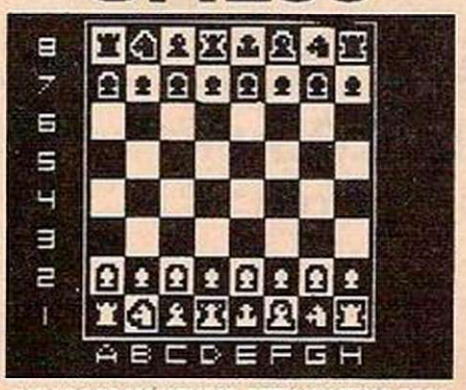
ALL PRICES INCLUSIVE
TELEPHONE 051 227 2642

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

VISA

BUG-BYTE

Acorn Atom CHESS

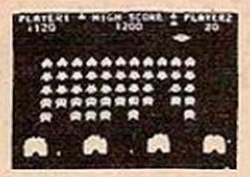


THE PROGRAM YOU'VE BEEN WAITING FOR!

Fantastic machine code chess game for the 12K Atom. Features include: split screen (high res. + alphanumerics); many levels of play; casting and en passant; computer plays black or white.

Supplied on cassette with instructions. **PRICE ONLY £9.00.** DON'T FORGET — OUR PRICES INCLUDE VAT AND POSTAGE.

ATOM INVADERS 12K, Gr. 4	£8.00
PINBALL 6K, Gr. 2	£4.50
ATOM BREAKOUT 4K, Gr. 1	£4.00
FRUIT MACHINE 8K, Gr. 2	£4.00
STAR TREK 12K, F.P.	£5.00
DISASSEMBLER 2K	£4.00
UFO BOMBER 7K	£4.00
LABYRINTH 12K, Gr. 2A, F.P.	£6.95
LUNAR LANDER 12K, Gr. 4	£5.50
BACKGAMMON 7K	£7.00
GOLF 7K, F.P.	£5.00
TYPIST 7K	£4.00
LAST RUN 7K	£3.00
WIGGLE + RHINO 10K	£5.00
SQUARES + SIMON + PARACHUTE 8K	£5.00
MINI-BREAKOUT + MINI-INVADERS 2K	£4.50
STATISTICS (4 programs) 12K	£20.00
2114L MEMORY CHIP	£2.00
C12 CASSETTE	£0.70



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 and attitude); allows you to guide your craft to the landing strip. On making your final approach the display changes to a high-resolution 3D 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**

VISA

ALL PRICES INCLUDE VAT & POSTAGE
24 Hour answering service on 051 227 2642 for Access orders.

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

BUG-BYTE

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.

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.

OAKLEAF COMPUTERS LTD

ACORN ATOM

New Colour Board £39
98K Discs Complete £299
Two Beginners Packs
1) 8K + 5K Atom + Colour Board + Power Supply + Introductory Pack (Includes 4 cassettes) £224.95
2) 8K + 2K Atom + Power Supply + 10 Programmes from Acornsoft To suit this machine £169.95

Buy it with Access
BARCLAYCARD VISA

Order by telephone quoting your card number; or write enclosing your remittance to:
109 DUDLEY ROAD,
GRANTHAM
LINCS. NG31 9AD
Tel: (0476) 76994

BOOKS

Getting acquainted with your atom £7.95
Atom business £6.95
Atom magic £5.50
Getting acquainted with your ZX81 £4.95
ZX 81 companion £7.95
Machine Language made simple ZX81 £8.95
49 Rip Roaring Games £5.25
NB. No PP or VAT on Books.

A	
Abacus Electronics	84
Acorn Dealers	9
Adda Computers	92
Adictive Games	74
AF Software	87
APE	6
Artic Computing	84
Audio Computers	22
Automata Cartography	88
AVO	6
Avon Computer	89
AXIS Computers	88
B	
Bridge Software	76
Buffer Microshop	86
Bug Byte	92
Butter Currie & Hook	39
Byte Shop	96
C	
Calculex	86
Cambridge Collection	40
Cambridge Learning	79
Compshop	19
Computer Bits	64
Computer Fair	54,55
Computers for All	5
Computer Cable Service	39
Computer Publications	82
Control Tech	8
Crofton Electronics	86
D	
Deans of Kensington	82
DKtronics	60,78
Drive Drove Video	90
E	
East London Robotics	83
ECCE Production	7
Educare	85
Edsoft	85
Elinca	87
Eltek	87
Essential Software (Visconti)	32,36
F	
Fuller Micros	82
Furlong Products	83
Future Soft	79
G	
Gilberton and Pothilot	6
Gower Publishing	85
Grey (JK) Software	76
H	
Harding A J (Molimerx)	29
Hewson Consultants	88
Hilderbay	3
I	
IO Systems	90
J	
JRS Software	84
L	
Laser Bug	91
Linsac	91
Lowe Electronics	2
M	
Macronics	74
MC Associates	7
MDR (Interfaces)	94
Melbourne House	81
Memotech	53
Michael Orwin	77
Mono Lith	33
Micro Age Electronics	7
Micro Game Simulations	80
Micro Gen	68
Micro Store	14
Micro Ware	40
N	
National ZX-81 Users Group	80
O	
Oakleaf	94
P	
Phipps Associates	36
Picturesque	77
Premier Publications	10
Program Power	83
Q	
Quicksilva	90
R	
RD Laboratories	77
Redditch Electronics	84
S	
S Electronics	94
Shiva Publicity	8
Silica Shop	63
Sinclair	47,48,49,50,95
Silicon Tricks	38
Silver Soft	79
T	
Tangerine Users Group	8
Technomatic	39
Timedata	74
Twickenham	80
U	
University Computers	40
V	
Video Software	78

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 16-kilobyte RAM pack provides you with more memory in one compact 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 rear existing expansion port on the back 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., CB21SN. Tel: 0276 66104.

To: Sinclair Research, FREEPOST, Camberley, Surrey, GU15 3BR. 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 03

VIC 20

See it here, buy it now

AT YOUR LOCAL BRANCH TODAY!

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.