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computing today

FOR THE BUSINESS OF MICROCOMPUTING

APRIL 1981
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65p

Acorn's ATOM in the spotlight
Does its BASIC have audience appeal?

Softspot special
Programs for almost everyone

Flights of fancy
We review the fantasy world of computer games

WORLD EXCLUSIVE
The BBC Micro Revealed

On the buses
Can a new CPU revive an old favourite?

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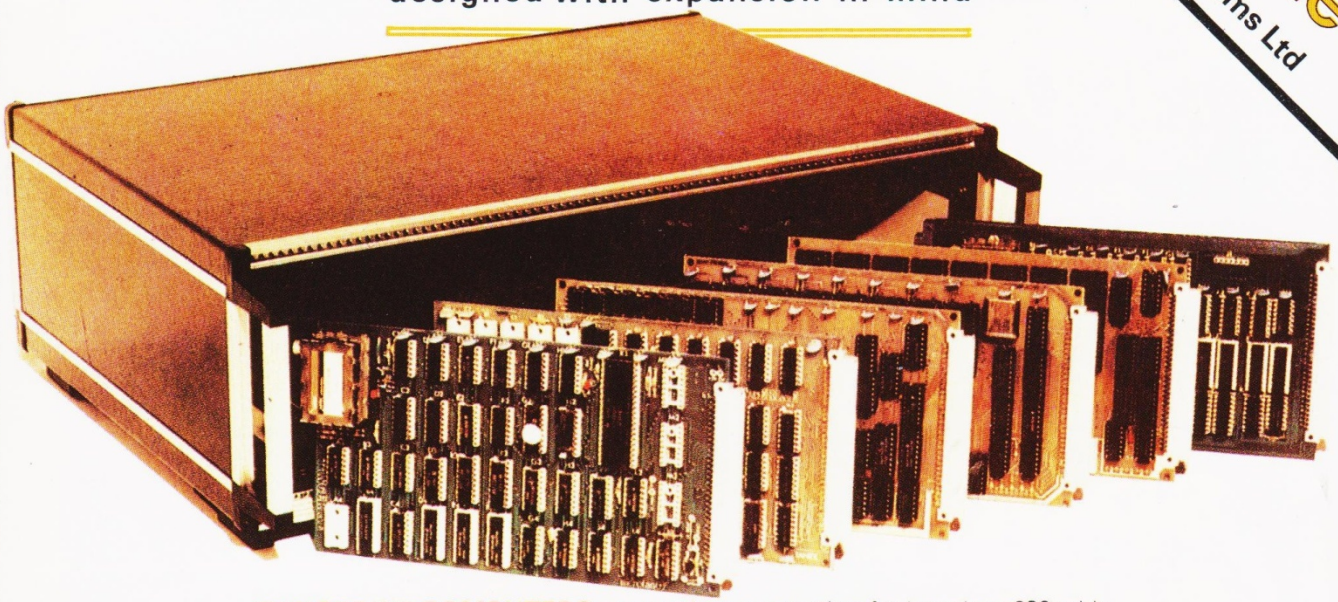

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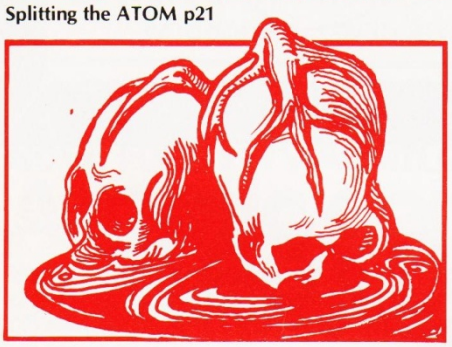

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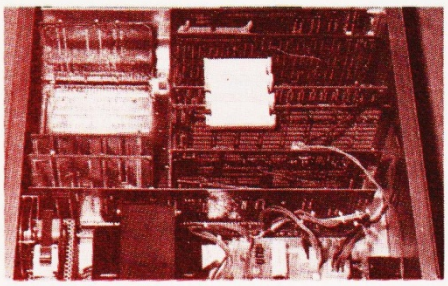

Double decker p38

Computing Today is constantly on the look-out for well written articles and programs. If you think that your efforts meet our standards please feel free to submit your work to us for consideration.

All material should be typed, but neat hand-written copy may be considered. Any programs submitted must be listed, cassette tapes and discs will not be accepted, and should be accompanied by sufficient documentation to enable their implementation. Please enclose an SAE if you want your manuscript returned, all submissions will be acknowledged. Any published work will be paid for.

All work for consideration should be sent to the Acting Editor at our Charing Cross Road address.

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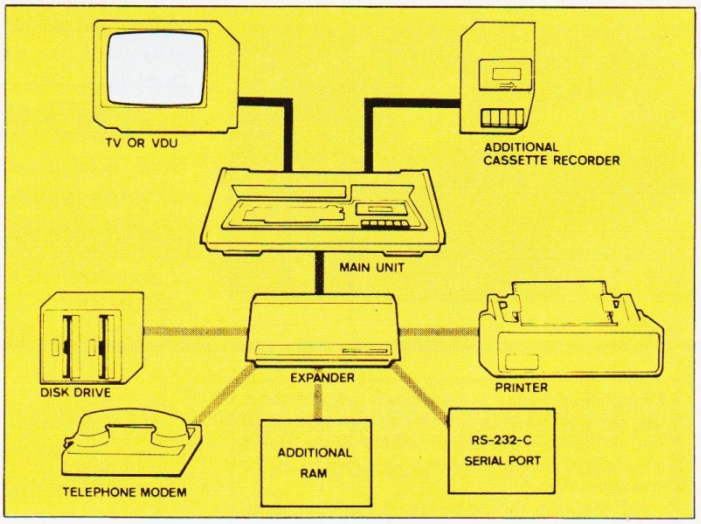

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ZX80

National ZX80 Users Club

For details of membership and a copy of the latest club magazine, send SAE to Dept. CT2, Unit 3, 33 Woodthorpe Road, Ashford, Middlesex TW15 2RP

BEST SELLER
MAKING THE MOST OF YOUR ZX80
by Tim Hartnell

Has now been re-printed for only £6.95. This book leads the ZX80 owner through over 60 programmes and helps him to create his own world wide sales. This proves to be a very popular and instructive book.

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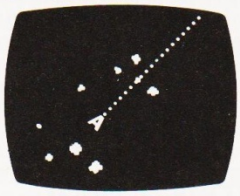

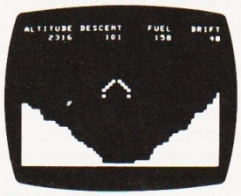

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6502 Books at Microdigital

Programming the 6502 – R. Zaks
This book is an educational text designed to teach programming, using the 6502. It does not require any prior programming knowledge, yet can be used to advantage by anyone wishing to familiarize himself with the 6502. An invaluable book for owners of the PET, Apple, Kim, etc. **8.70**

6502 Applications Book – R. Zaks
This book presents practical applications techniques for the 6502 ranging from a complete home alarm system to an industrial control loop for temperature control. Also includes analog to digital conversion and simple peripherals from paper-tape reader to micro printer. **8.70**

6502 Games – R. Zaks
A book of ten games which will teach you assembly language, algorithm design and data structures in a straight-forward and enjoyable manner. **8.90**

Programming a Microcomputer (6502) – Foster
This book will teach you how to program a microcomputer in machine language. Although designed specifically for the 6502 microprocessor used in the Kim 1, PET and the Apple. The basic principles involved apply to all computers. **7.20**

Practical Microcomputer Programming The 6502 – Weller
This book examines the detailed assembly level programming characteristics of the 6502 microprocessor and includes appendices giving an assembly listing of the assembly program (6502 Resident Assembler) an assembly listing of Apple II input/output subroutines for the assembly computers and assembly listing of the D-Bug program for Apple II. A very comprehensive reference book. **19.50**

6502 Assembly Language Programming – Leventhal
Another fine manual in the Osborne Assembly Language series to join the best selling 8080, 6800 and Z-80 books. **10.45**

6502 Cookbook – R. Findley
Various component programme units given may be combined at will, and these recipes will help you to explore some of the possibilites available. **7.70**

Programming and Interfacing the 6502
An excellent starting point for 6502 micro-computer novices, who need experience in assembly language programming or chip-level interfacing. Examples are shown using a KIM, AIM or SYM system. **8.90**

6502 Software Design – L. Scanlon
Fundamentals of 6502 operation are explained and then extended to give a comprehensive coverage of 6502 use. **7.90**

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RESOLVING NASCOM'S GRAPHICS

What appears to be an extremely neat add-on for NASCOM 2s has been introduced by Bits & PC's of 4 Westgate, Wetherby, West Yorkshire LS22 4LL. Consisting of a small PCB (5" by 4½") it offers user definable graphics to a resolution of 86016 dots. With a small modification to the original NASCOM, to overcome a design flaw, this can be increased to a resolution of 384 by 256, a total of 98304 dots. The board is piggy-backed into the graphics ROM socket, this is then re-sited on the new board. The graphics set displayed can be software switched from the standard set to the new, user-programmable set by adding two wires, these do not use any of the on-board I/O capacity. Each new character cell is made up of 128 dots and the user can generate up to 64 new character cells at this level. Once defined these can be placed anywhere, and in any quantity, on the screen with a maximum of 768 displayed cells at any one time. You can intermix normal alphanumerics and the new characters on the display. Demonstration software and an editor to make character definition easy are supplied with the kit.

MUSIC TO MY EARS

Worry not, the mistreated Apple in this photo is a one-off publicity thing built to promote the range of new, computer controlled music generators from ALF. Distributed in this country by Microsense there are two Apple cards in the range, the MC1 which has nine independent "voices" and the MC16 which offers three. Prices are £91 and £114 respectively. Also available is an 'Ear Training Drill' which uses the MC16 card and Apple's high resolution graphics to provide training on a range of musical skills. Also announced by Microsense this month is the new range of Paper Tiger printers. The 445 replaces the existing 440 and costs £545, the new 460 offers high density printing using a staggered matrix head and the new 560 which is a high quality 132 column matrix printer. Prices for the latter two are £795 and £995 respectively. More detailed information can be obtained from Microsense at Finway Road, Hemel Hempstead, Herts HP2 7PS.

THE BBC COMES HOME

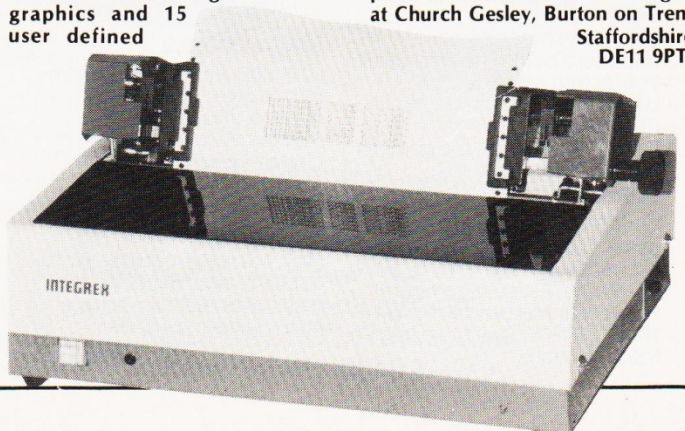
You can hardly have failed to hear about the planned series of computer literacy programmes due to be shown on BBC Television soon, whether through these columns or in the trade press. Hand-in-hand with the comment on the pros and cons about computer education has been a considerable amount of speculation over the actual computer the BBC are going to use in conjunction with the programmes. First one company then another has held the headlines but, until just a few days ago, no final decision had been taken. That has now happened and, indeed, the BBC have announced that they have taken the decision. Computing Today has taken a very close interest in the project during its development over the last year and we are now able to bring you the details on the BBC micro. The computer is being manufactured specially for the BBC by Acorn Computers of Cambridge, the people who make the ATOM reviewed elsewhere in this issue, and is expected to sell, under licence from BBC Enterprises, for around £200. Based on a 6502 CPU it has a built-in keyboard and drives a conventional domestic TV. The language it runs will be a superset of the existing ATOM BASIC but compatible in most respects to the Microsoft BASIC 5 language. This occupies some 16K of ROM, another 16K of ROM contains the monitor and associated routines. There is a total of 16K of RAM on-board the basic machine which can be expanded to 32K.Up to 20K of this user memory can be used for the video RAM giving high-resolution graphics in both colour and black and white. The RAM memory can be further expanded to 96K using the second CPU option. A number of interfaces are present; RS232, Centronics type parallel, CUTS 300 or 1200 baud cassette and a Teletext adaptor interface. Options include an Econonet interface and a custom daisy printer interface. The main unit can also be expanded by way of the existing Eurocard system. The Teletext option will only be available on the BBC machine and will allow Telesoftware to be downloaded off-air. The VDU format can be selected to 25 by 40 (Teletext format) or 25 by 80 for high resolution graphics, in the latter mode there are 640 by 256 dots in B&W or 320 by 256 dots in colour. Expansion into the realms of discs will be possible using the second processor. In the BBC machine this will probably be CP/M running under the control of a Z80. The controller will be built-in but, like many of the options, be chipless although firmware is supplied for Acorn's own DOS.To upgrade all you have to do is plug in the right components. The series of ten programmes will be first transmitted between January and March 1982 on Sunday mornings on BBC1 between 10.10 and 10.35 starting on January 10th and then repeated on the following Monday afternoon for schools and colleges. The first showings of the pilot programme to test audiences were made last week and the results seem very favourable.

SINCLAIR DOES IT AGAIN

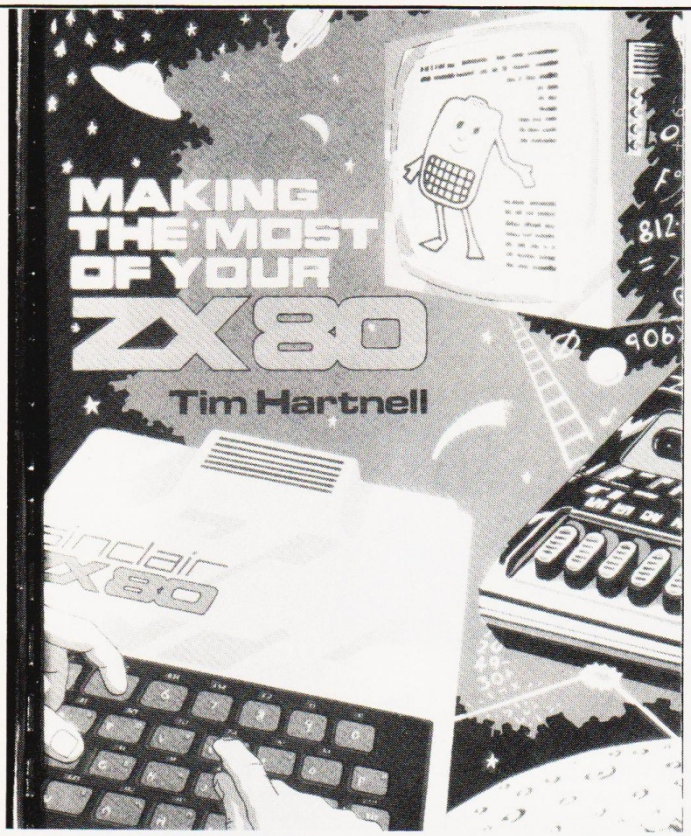
Would you believe a micro using only four chips? We took a little bit of convincing but it has been done,it's called the ZX81! Taking the technology used in the ZX80 one stage further and increasing the capability of the BASIC he's come up with what might well be another winner. Using the new 8K BASIC designed for the ZX80 (with printer routines) and a new keyboard overlay the unit is reduced in price to £49.95 for the kit and £69.95 ready built. Looking at the keyboard reveals a number of new BASIC commands and two keys labelled 'fast' and 'slow'. These overcome the much quoted display problem of the ZX80 in a very cunning way. In 'slow' mode the CPU only processes information during that fraction of time when the TV screen is blank, creating the illusion of continuous movement. In 'fast' mode the screen is blanked and the CPU runs continuously. In terms of program execution this means that the ZX81 will run BASIC as fast as it possibly can unless you want something displayed on—screen, then it will run very much slower. Existing ZX80 users can use the new ROM on the ZX80 and their 16K memory units will also work on the new ZX81.

COLOUR IN PRINT

Shame that we can't print colour pictures in this part of the magazine because this new printer from Integrex does just that; printing in colour. Costing a mere £895 (plus VAT) it can print, in seven colours, the 96 character ASCII set together with 64 graphics and 15 user defined characters. All printing functions including reversed characters and double sized printing are under user control. Supplied with a Centronics interface the unit prints at 125 cps, other interfaces are available as options. Details and a sample colour printout are available from Integrex at Church Gesley, Burton on Trent, Staffordshire DE11 9PT.



CONSUMER NEWS



MAKING THE MOST OF YOUR ZX80

An interesting book. At first sight of the pages you would be forgiven in thinking — "another of those fairly expensive listings of programs, found monthly in the regular magazines". NOT SO, Tim Hartnell has certainly provided the reader with many varied programs but in the text linked to most of these listings is a well thought out "hands on" learning approach. In his introduction he suggests that many of us, having bought a ZX80 and waded through the manual, are left with a rather limited repetoire of what we can usefully do with our brand new computer. I'm sure this is true in many cases. With the very widely based advertising that Science of Cambridge have pursued there are probably a host of would be programmers just waiting for inspiration. This book could provide that trigger to firmly push them on their way. An instruction book can be a very dry piece of text, the ZX80 operating manual is not like this and puts over the main commands in a fairly digestible manner but, having done so, there is the need for something extra to cement our new found knowledge. This book provides that next step in a easily understood way. As you work your way through it, not only does your library of programs grow but also your understanding of the BASIC commands which make them possible. Throughout its pages will be found many routines that will serve as the basis for subroutines to be incorporated in your own programs. There are a large number of games ranging from the very simple to those that could well be developed into ones that will tax your ingenuity and patience to the limit. There is also a section that introduces the possibilities of using the ZX80 as a simple teaching tool (although I think it has limited potential unless used with the larger memory options). The book closes with some useful subroutines and a re-appraisal of the ZX80's functions (4K and 8K ROMs). A book to be recommended to the ZX80 owner. One or two of the programs appear to have the odd error or ommission but these only tend to keep the reader/programmer on his/her toes and are easily rectified! MAKING THE MOST OF YOUR ZX80 is written by Tim Hartnell, published by Computer Publications and will cost you £5.95 for its 108 pages. ISBN 0 907442 00 5

TEXAS' BIGGER STAKE

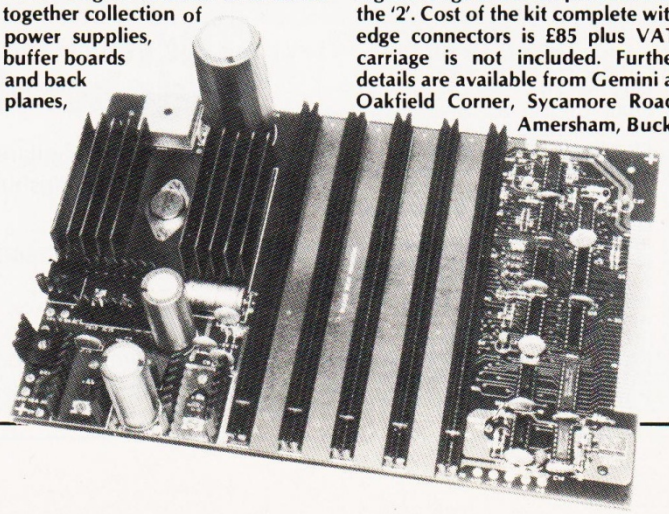
In an attempt to win itself an even bigger slice of the potentially enormous data terminal and small computer printer market Texas Instruments have cut their prices by up to 20%. Devices such as the ever popular Model 810 are down by £200, and this is reckoned to be one of the most reliable matrix printers in the marketplace. Also recently announced, and of interest to the micro person, is the new TMS9909 floppy disc controller. This is suitable for both eight and 16 bit CPUs and includes several unique features. For details on both the price reductions and the new disc controller contact Texas at Manton Lane, Bedford MK41 7PA.

ON COURSE AGAIN

I P Sharp Associates are offering a variety of courses in APL both in London and at their regional outposts. The introductory course is a one-day session and takes place, in London, on April 2nd, May 29th and June 19th at their offices in Buckingham Palace Road, SW1W 9SA. Follow-on sessions include a three-day beginners' course, a three-day intermediate course and a two-day advanced course. Regional offices are situated in Gloucester, Coventry, Warrington (vere else!) and Aberdeen. All enquiries should be directed to Sally Drew at the London Office and you can ring on 01-730 0361. Also offering APL courses are A P Limited of Maple House, Mortlake Crescent, Chester CH3 5UR. They have a three-day beginners' session starting on April 27th, May 25th, June 22nd and a five-day session starting on July 27th. Also offered are two-day sessions on advanced APL techniques which start on May 28th, June 25th and July 23rd. Contact the Course Administrator at the above address for further details. For the business minded among you Kalamazoo are offering a series of two-day demonstrations aimed at 'dispelling the myths about microcomputers'. Sessions are being held in Watford, Croydon, Cardiff, Southampton and Maidstone so if you wish to find out more contact Kalamazoo direct at Northfield, Birmingham B31 2RW or telephone 021-475 2191. If the idea of a weekend course is more to your liking then Agar Computer Services of 194 Kilburn High Road, London NW6 may have something to offer. They have intensive two-day BASIC weekends starting on April 11th and 25th and May 9th and 23rd. Each costs £57.50 inclusive of VAT and further information can be obtained from the above address. And, finally, EDI Electronics Engineering Ltd are holding free monthly microprocessor clinics at the National Microprocessor and Electronics Centre in London. Anyone interested in attending should contact Alan Young at EDI on 0473-211222 or Graeme Mitchell at the Centre on 01-488 2400.

ONE'S MOTHER?

As an elegant solution to a lashed together collection of power supplies, buffer boards and back planes,



Gemini Microcomputers are offering the 'Supermum', Oedipus never had it so good! Specifically designed for NASCOM 1 owners it is a backplane which provides a five-slot NASBUS with full buffering and power supply. The board will fit over a '1' and allow it to be expanded using the range of boards produced for the '2'. Cost of the kit complete with edge connectors is £85 plus VAT, carriage is not included. Further details are available from Gemini at Oakfield Corner, Sycamore Road, Amersham, Bucks.

CLUB CALL

It's nice to see that the world of the Computer Club is still flourishing. News this month is nothing special but rather an update on some old friends. First, let me say 'Welcome Back' to the ACC who finally seem to have got their collective self back into at least some semblance of shape. The UK101 User Group is going strong with members coming from as far abroad as New Zealand and Scandinavia. Their address is 9 Moss Lane, Romford, Essex RM1 2QB and they produce what appears to be a well put-together newsletter. Anyone into PILOT will be interested to hear of the existence of a UK User Group. Co-ordination is by Alec Wood at the Wirral Grammer School for Boys, Cross Lane, Bebington, Wirral, Merseyside L63 3AQ. They also offer a selection of PILOT Interpreters for various machines. The group formerly known as SPEC is now called the European Sorcerer Club, still looked after by Colin Morle at 32 Watchyard Lane, Formby, Liverpool L37 3JU. The change of name was a result of some confusion with another, inactive, user group and also in recognition of the large European user family. The Dutch TV service have recently broadcast a computer series based around the Sorcerer but according to my sources this was not terribly well received, perhaps our own BBC series will prove rather more interesting. The National TRS-80 Users Group is one of the most consistent in the quality of its output and has recently formed a London branch under the guidance of John Wellsman. Details can be obtained from him at 292 Caledonian Road, London N1. And, finally, I apparently forgot to give a mention to the oddly named BASUG. This is the British Apple System User Group, ITT 2020's are welcome too, and anyone interested should contact John Sharp on Garston (09273) 75093.

THE PRINTER YOU THOUGHT YOU COULDN'T AFFORD....

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Standard Centronics interface and optional interface make it ideal for most hobby Micro's.

Printout sample of GP80 (reproduced same size)

The GP-80 is a revolutionary new graphic printer with a difference, not only does it have an amazingly low price, but unlike its competitors the GP-80 uses a unique 'Uni-hammer' system and with a name like Seikosha behind it you can be sure of its quality, reliability and precision construction. The GP-80 is an ideal printer for your system (all interfaces for the popular makes) or VDU, and it produces a top quality printout.*

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Allow 14 days delivery, subject to availability, full refund if goods returned within 14 days.

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● The picture shows mixed graphics and characters in three colours

Special features include

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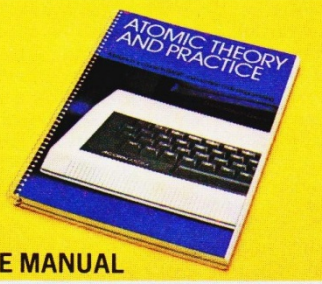
Just connect the assembled computer to any domestic TV and power source and you are ready to begin. (Power requirement: 8V at 800mA). There is an ATOM power unit available – see the coupon below.



FREE MANUAL

Free with every ATOM, kit or built, is a computer manual. The first section explains and teaches you BASIC, the language that most personal computers and the ATOM operate in. The instructions are simple and learning quickly becomes a pleasure. You'll soon be writing your own programs. The second section is a reference manual giving a full description of the ATOM's facilities and how to use them. Both sections are fully illustrated with example programs.

The standard ATOM includes:

HARDWARE

● Full-sized QWERTY keyboard ● 6502 Microprocessor ● Rugged injection-moulded case ● 2K RAM ● 8K HYPER-ROM ● 23 integrated circuits and sockets ● Audio cassette interface ● UHF TV output ● Full assembly instructions

SOFTWARE

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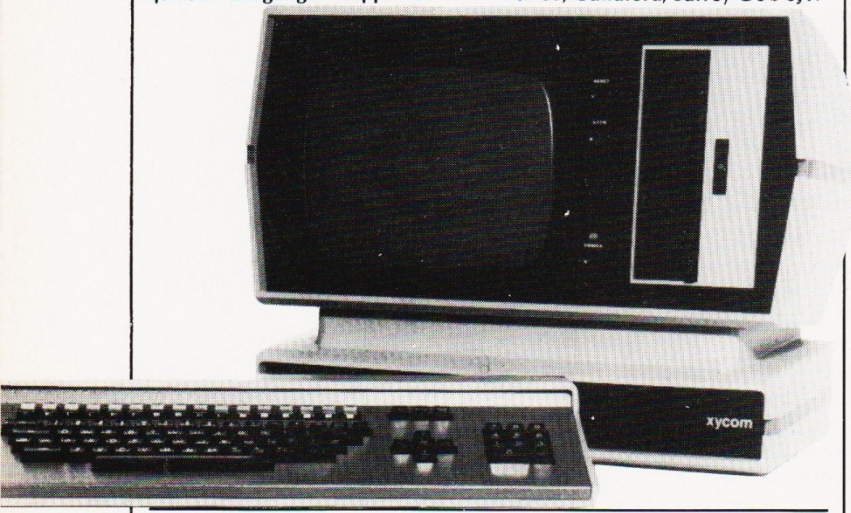
TANTEL ANSA'S PHONE!

The Prestel adaptor launched by Tangerine Computers that we announced some months ago in our News pages has really taken off in the marketplace. So much so that Viewdata Business Systems, a division of Ansafone, has taken on a distributorship. Sized at 9½" by 6½" by 2" and only needing two simple connections it is proving extremely popular in both the domestic and business markets. VBS are offering the device ex-stock at £170.00 plus VAT (mail order) or £199.00 plus VAT installed and running. For details contact them at Lyon Way, Frimley Road, Camberly, Surrey GU16 5EY.

SOLO DEVELOPER

A new desk-top Z80 based development system is being offered by Monolog Systems called the Xycom 3805A. Capable of running a number of software packages on a single hardware unit it is mainly intended for program development but can act as a general purpose micro if required. Languages supported include BASIC, FORTRAN, RTX and Industrial Pascal. On the hardware front the machine sports 96K of RAM, and an integral 12" VDU with remote keyboard, 250K of IBM 3740 format floppy disc storage and a line printer. Options include an EPROM programmer and more discs up to 750K. For further technical and pricing details contact Monolog at PO Box 53, Guildford, Surrey GU5 0JT.



SUN SHINES IN THE EAST

The range of ABC computers from the Ai Electronics Corporation of Japan are to be distributed in the UK by Sun Computing Services of Feltham. Included in the range are the ABC 24 and 26. Both models share the same facilities except that the dual 5¼" floppies of the 24 are upgraded to 8" units on the 26. Other features include 12" integral VDU with detached keyboard, two serial I/O ports and a wide range of operating systems including CP/M, MP/M and DOSKET. Languages include BASIC and COBOL and a range of specially prepared packages are available. Prices start at £3350 for the 24 and at £4750 for the 26. For details contact Sun at 138 Chalmers Way, North Feltham Trading Estate, Feltham, Middx TW14 0UN.

CENTRE GOES SMALL

The National Computing Centre has just formed a new division called the Microsystems Centre. Its aim is to assist and educate potential users of micro-based equipment up to £15,000 in value. Funds for the Centre are being provided through the DoI but it is anticipated that as the numbers using the service increases it will become self funding. As an additional help to firms, both new and old, in the computer market the NCC has just published three new directories. These cover Hardware, Software and Suppliers and cost £30, £30 and £10 respectively. From a brief look at the contents they appear to be extremely good value for money. For details on these and the many other services offered by the NCC contact them at Oxford Road, Manchester M1 7ED.

CHEAP CROMEMCO

One of the cheapest S100 bus based computers around, the Cromemco System Zero,is to be distributed by Datron of Sheffield. Designed for use in dedicated situations such as research it is equipped with a Z80A CPU, 1K of RAM and a 3K Control BASIC in ROM. Space is available within the chassis for a further three S100 cards. A special version, designated the System Zero/D is available equipped with 64K of RAM and a disc control card capable of supporting 5¼" floppies, the DOS is built – in. Software for the system includes FORTRAN, COBOL, LISP and two versions of BASIC as well as some applications programs including wordprocessing and database management. Prices start at £597 and go up to £2450 for a version with twin drives.

IN TRIPLICATE

If your business uses multi-part carbonless stationery then the chances are that it's Idem's. This division of Wiggins Teape has had such success in the computer stationery field that it has launched yet another of its three-part calendars to brighten up the offices of DP departments. A convenient 97 by 34 cm in size it will decorate any lonely wall. For details of the calendar, and their range of carbonless business stationery, contact Idem at Gateway House, Basing View, Basingstoke, Hants RG21 2EE.

APPLE INCORPORATE

Microsense, the main UK distributors of the Apple computer for the last year or so, have announced that they are to become a wholly owned subsidiary of the American company. Michael Brewer, currently Chairman of Microsense, will become the new managing director. It would appear, however, that this move will not reduce the cost of the machine in the shops although increased technical back-up is scheduled. The much awaited Apple 3, currently being evaluated by the dealers, should be available for public consumption in April, what will happen to the rumoured Apple 4 was not forthcoming when I spoke to Michael Brewer. Financial details of the deal have not been released but the figures were said to be "a very good deal". Full transition should have occurred by the Autumn.

TWO WORDS TOGETHER

Potential users of the 8000 series 'SuperPET' computer will be relieved to hear that someone has worked out how to connect a standard information package to two of the most popular wordprocessor packages. Compsoft have coupled their DMS software to both Wordpro and Wordcraft making it possible to prepare selective mailing lists of, for example, all those people who didn't buy anything from you last month! You can also use already stored information to build up a set of standard letters, which you have prepared on the wordprocessor. The system is Commodore approved and will cost you £190 in either CBM or Compu/Think formats, a CP/M version should be available soon for £330. Further details are available from Compsoft at Old Manor Lane, Chilworth, Guildford, Surrey.

BUSINESS NEWS

HP = HIGH POWERED!

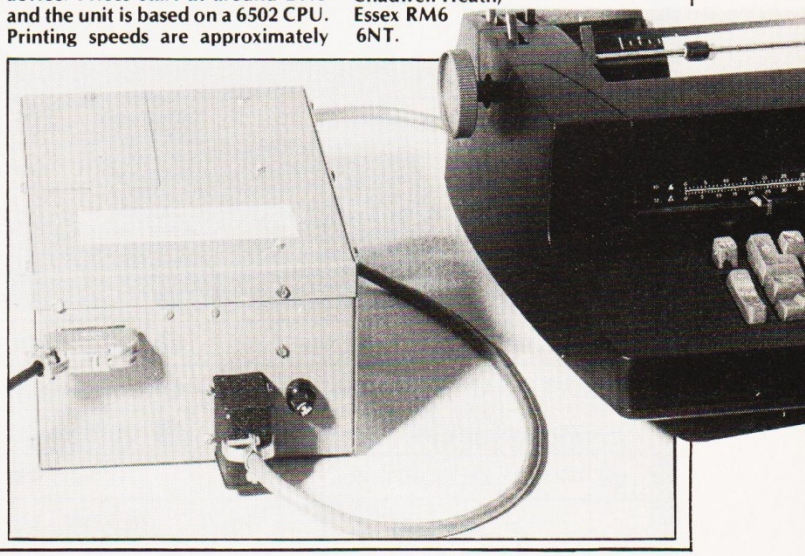
Hewlett Packard have introduced a cut-down version of the HP 85 personal computer priced at £1,210. Identical to the 85 with the exception of the integral printer and magnetic tape cartridge units, it provides a starting point for what is now called the Series 80 range. A number of new peripherals and software packages have been launched at the same time, the latter includes an Assembler ROM priced at £159 and an enhanced version of the VisiCalc electronic worksheet. The Assembler provides access to many of the routines in the BASIC including all the maths and utility sections. The user can create programs or alter the BASIC by adding new commands, redefining keywords or by adding I/O controls. Among the peripherals offered are a range of discs and printers as well as a new graphics tablet, the HP9111A. Drawings made on the tablet surface are automatically stored in memory and displayed on the screen, the cost is £1,071. Unconnected with the launch of the '83' but also recently announced is a new daisy wheel printer, the HP2601A, priced at £2,471. Based on a Diablo design it offers all the normal functions as well as in-built proportional spacing, underlining and justification. Printing is at 32 cps with a metal wheel or 40 cps with a plastic wheel. For further details contact HP Personal Computation Products Group at 308/314 Kings Road, Reading, Berkshire.

SHOWING OFF AGAIN

The second annual London Computer Fair is to be held at the Polytechnic of North London between the 14th and 16th of April. Over 26 exhibitors have booked stand space at the show including Science of Cambridge, Mine of Information, Midwich, Acorn Computers and The Software House. A number of user groups will also be represented; the ZX80 National Users, BASUG and ITUG being just three. By the time the Fair opens its doors the North London Community Computer Centre should be running and this is to become part of the Federation of Microcomputer Centres organised by the NCC. It is hoped that the Centre will be providing a continuous demonstration of software and hardware during the Fair. Two workshops will be held, Educational on the 15th and Hobbyist on the 16th. Computing Today staff will be around and about and rumour has it that one of them might even be persuaded to talk.

SELECT A SELECTRIC

Offices who are considering new technology such as wordprocessors may be able to save a considerable amount of money by converting some of their existing typewriters into high quality printers for the new system. Produced in the USA, but now marketed in this country, is a conversion interface that allows a standard IBM golfball typewriter to be used as a computer output device. Prices start at around £415 and the unit is based on a 6502 CPU. Printing speeds are approximately 160 wpm and the normal keyboard operation is unaffected allowing the operator to insert names etc, into standard letters. The normal interface is RS232 with baud rates between 75 and 19200 but a parallel version is also available. By changing the internal PROM a wide variety of different golfballs may be used. For details contact Data Resources at Caldare house, 144-146 High Road, Chadwell Heath, Essex RM6 6NT.



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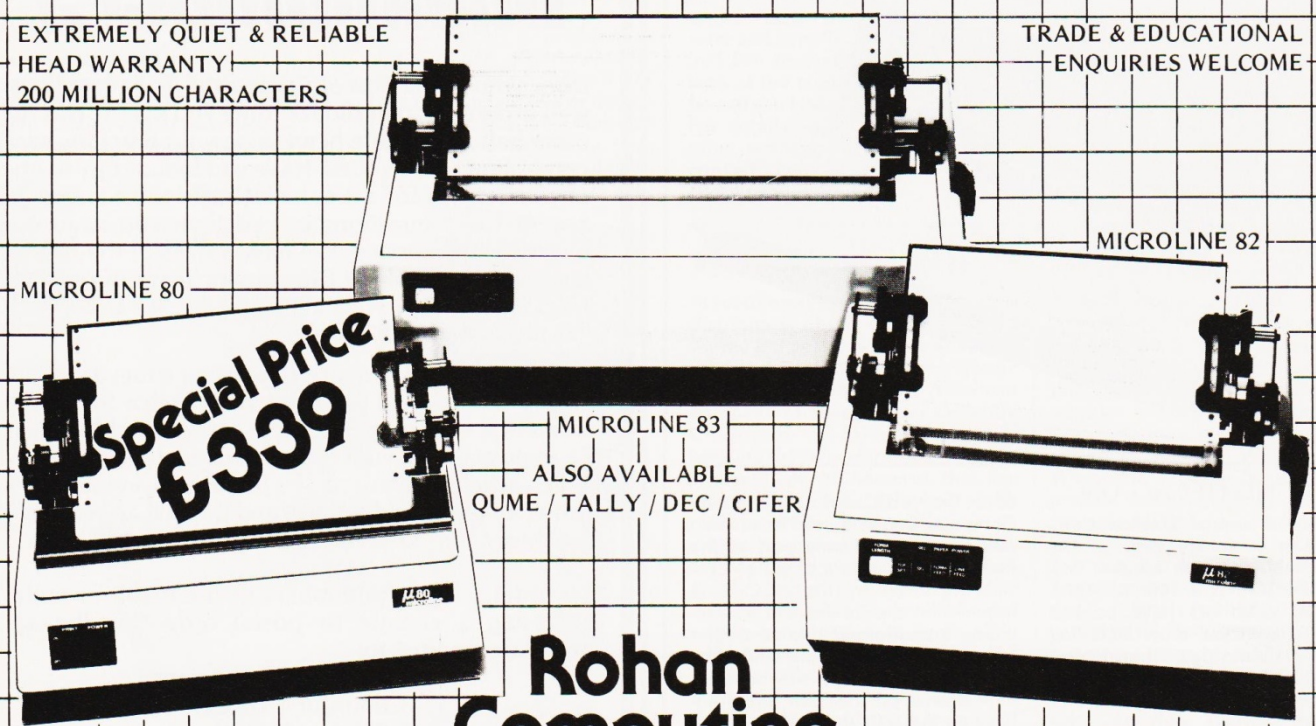

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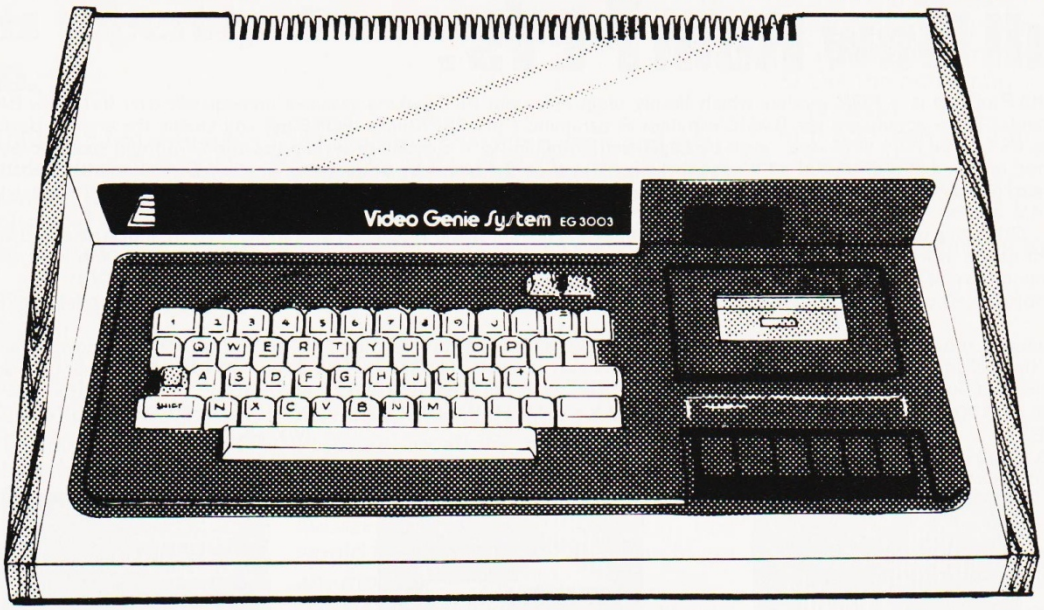

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Microdigital are the hardware experts – here's why you should buy your Genie from us. ★ Low Price of £280 + VAT. ★ Each computer tested by our engineers before despatch. ★ 12 month parts and labour guarantee. ★ Free delivery within mainland U.K. ★ Bona fide official orders welcome. ★ Latest version of Genie.

The Video Genie is a complete computer system, requiring only connection to a domestic 625 line TV set to be fully operational; or if required a video monitor can be connected to provide the best quality display.

The system case contains the Central Processor Unit (CPU), 16,000 bytes RAM memory, the cassette system, a 12,000 byte operating system and BASIC interpreter in ROM, and a full size keyboard, in a stylish case, at a price that makes the Video Genie better value than some "kit" computers.

Applications

The Video Genie System has many uses in all spheres of life, the easy to use BASIC language means that programs are easily written for specific applications, and pre-recorded program tapes are available in great variety.

The system has great scope in the home, sophisticated games programs can introduce the computer age to all the family, who can then progress to writing their own programs in BASIC or even machine code. Software is continuously being developed to aid home budgeting and education.

In a school or college the machine can be used with a large screen TV to allow a whole class to be taught at once.

The powerful Extended BASIC interpreter makes the solution of complex scientific problems simple, and the graphics allow pictorial displays of results.

Prices	Nett	Vat	Total
Video Genie Computer	280.00	42.00	322.00
EG3013 Expander with RS232	215.00	32.25	247.25
EG3013 Expander without RS232	185.00	27.75	212.75
32K Memory Board S100	130.00	19.50	149.50
16K Memory Board S100	95.00	14.25	109.25
Dual Disk Drive (40 track)	410.00	61.50	471.50
2 Drive Cable	17.00	2.55	19.55
4 Drive Cable	32.00	4.80	36.80
Printer Cable	17.00	2.55	19.55
Centronics Parallel Interface for unexpanded Genie	33.00	4.95	37.95
Sound kit	10.00	1.50	11.50
fitting above	5.00	.75	5.75
Lower case kit	35.00	5.25	40.25
fitting above	5.00	.75	5.75

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The PIC-CHIP.... a powerful easy-to-use graphics facility for all New Rom PETs.

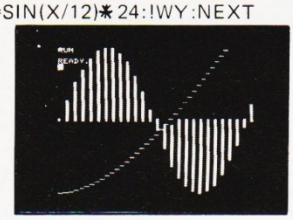
The PicChip is a ROM module which simply plugs into your PET making available immediately over forty new BASIC commands. These commands use BASIC variables as parameters (no PEEKing or POKEing) and enable the graphic possibilities of the PET to be fully exploited - even by beginners! Using an X, Y coordinate system based on an origin specified by program, lines, graphs and drawings of all kinds can be generated on the screen by simple programming. Other commands enable defined areas, or the whole of the screen, to be rolled or shifted up, down, left and right. Images can be stored to and retrieved from any RAM address.

Originally designed for **scientific** and **technical** applications, the PicChip is also being used in **educational projects, games** and **design work** of all kinds. The combination of fast plotting and area manipulation makes the PicChip ideal for the continuous display of real-time data in graphical form.

Just see how easy it is to use PicChip commands: the following examples were all photographed directly from a PET screen.

Picture 1 shows two curves, one drawn in fine-density and one in bar form, produced by two program lines:

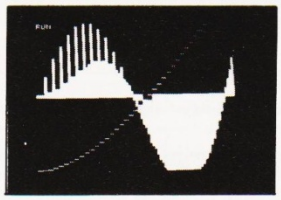
```
10 FOR X=0 TO 39:Y = X↑1.5:!WF:
NEXT
20 Y0=25:FOR X=0TO79 STEP 3:
Y=SIN(X/12)✱24:!WY:NEXT
```



(1)

Picture 2 adds a third program line to plot a function as adjacent bars:

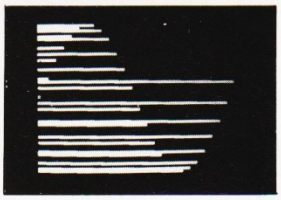
```
30 FOR X = 0 TO 79:Y=SIN(X/12)✱
X/2:!WY:NEXT
```



(2)

If we just take the second program line and change !WY to !WX, the bars are plotted horizontally:

```
20 FOR X = 0 TO 79:Y=SIN(X/12)✱24:
!WX:NEXT
```

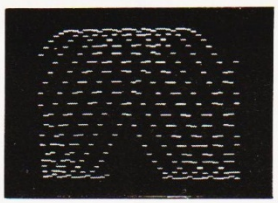


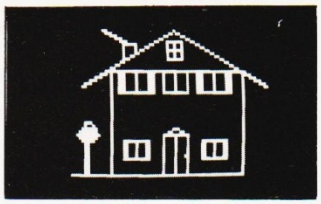
(3)

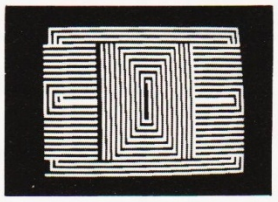
All the other pictures reproduced here were generated by the DEMONSTRATION PROGRAM included in the 20-page Handbook. What we can't show here are the amazing effects produced by shifting or rolling or otherwise manipulating different areas of the screen. There is even a repeat-key function, and commands for reading and setting the cursor position in X,Y co-ordinates.

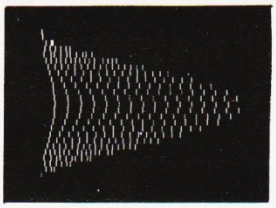
PicChip Functions.

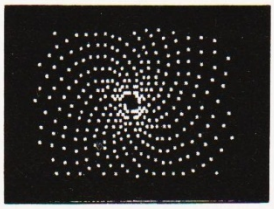
Command	Function
SYS 45056	PicChip On
!RE	Restore screen
!CO	PicChip off
!RP	Repeat-Key on
!RO	Repeat-Key off
!CW	Cursor-position Write
!CR	Cursor-position Read
!AF	Area Fill
!AR	Area Reverse
!AN	Area Normal
!AI	Area Invert
!AS	Area in Shift case
!AU	Area in Unshift case
!AC	Area Case invert
!AF	Screen Fill
!SR	Screen Reverse
!SN	Screen Normal
!SI	Screen Invert
!SS	Screen in Shift case
!SU	Screen in Unshift case
!SC	Screen Case invert
!US	Up Shift
!DS	Down Shift
!LS	Left Shift
!RS	Right Shift
!UR	Up Roll
!DR	Down Roll
!LR	Left Roll
!RR	Right Roll
!WP	Write Point
!EP	Erase Point
!WL	Write Line
!EL	Erase Line
!WC	Write Continuous line
!EC	Erase Continuous line
!WX	Write bar in X axis
!EX	Erase bar in X axis
!WY	Write bar in Y axis
!EY	Erase bar in Y axis
!WF	Write fine Y
!EF	Erase fine Y
!FW	Write fine X
!FE	Erase fine X
!CS	Copy Screen
!PC	Poke Character











The standard PicChip plugs into socket UD4 of the PET, but is also available to fit either of the other two sockets. PicChip is therefore **compatible with other PET ROM packages.** Installation and use are fully described in the handbook.

The PicChip costs just £50 + VAT. To buy the handbook separately costs £5 but this may be offset against an eventual purchase of the chip. State required socket when ordering. **10% discount to educational institutions.**

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FAST PLOTTER

A Lacy

Let your TRS80 take the strain for plotting all those complex functions with this superbly documented program.

In the dim and distant past I remember gazing at microcomputer advertisements showing (apparently) all manner of graphs and mathematical symbols flowing across the screen. When I finally got my hands on a machine I soon found out the sad truth. The TRS80 certainly has graphics capability in the form of SET and RESET functions, but ever so slow!

POKE and PEEK also give access to the display but the speed is not much better, the fastest method of all in BASIC is to PRINT a string containing graphics characters. This method is very successful when small areas of the display are to move, but I still want to see those sine waves rippling across the screen!

The method shown here is a machine code program which sometimes needs to be slowed down to give a viewable display. I shall firstly describe the machine code program itself then show you how to interface such a program to a BASIC language program.

The Machine Code

This is for your information only, don't worry, you don't have to type in any assembly code to use the graph plotter. All of the references to line numbers in this section are for the assembly code listing. Lines 10-120 are the equivalent of REM statements in BASIC, I include these in my 'library' of source programs because I find assembly code very 'opaque', that is, the program itself does not suggest how it works. This is also the reason for all the comments down the right hand side of the listing.

The CALL on line 170 is used to get information from the BASIC program, after this call has been made the HL register pair contains a value corresponding to the value V in the BASIC statement: 10 X=USR(V)

Lines 200-260 are mainly concerned with setting up loop parameters, the equivalent of the FOR. . . NEXT statement. As in any program the input variables need to be tested and the appropriate action taken if they are out of the desired range. This is done on lines 230-240, if the variable is greater than 40 then the loop contents will be skipped and the next variable will be processed. I chose a value of 40 because the screen is 48 graphics characters high and space might be needed for axis and other information. The values in the program will give one free line at the top and three at the bottom. Similarly 'XAXIS' defines the display width as numbers of graphics characters. The maximum is 128, and I chose 120, giving some free space at the screen edges.

If the check on line 240 is not made then values could be input which caused memory locations other than screen memory to be loaded, possibly in the areas of RAM used by the TRS80's housekeeping routines. Most likely you would have to reset the machine to get any more sense out of it!

At this point you need to know how TRS80 graphics are accessed from machine language. In the TRS80 there are two graphics chips, one contains all the information required for the ASCII character set (and more if you know how to get it out), the other is really a bit of TTL which switches on graphics blocks at the right instant of time during the screen scan. If bit 7 in the screen memory location being accessed is set, at logic "1", then the graphics generator will turn on, otherwise the ASCII generator will be enabled. So, we know that we must turn on bit 7 at the required location.

But what is that location? Well a bit of arithmetic is needed to calculate it and this calculation is what comprises the bulk of the program. Each graphics block corresponds to a byte of memory and is three graphics characters high and two wide. The characters themselves correspond to bits in the memory byte as shown in Table 1.

GRAPHIC CHARACTER DISPLAYED	BIT POSITION	EQUIVALENT VALUE (HEX)
A	0	1
B	1	2
C	2	4
D	3	8
E	4	10
F	5	20
NOT USED	6	40
ALWAYS 1 FOR GRAPHICS	7	80

A	B
C	D
E	F

Table 1. This shows the relationship between display memory bytes and the character displayed on the screen

We must determine the bit to be set as well as the correct location, the procedure used is listed:

1) Divide the variable by three.	260-290
2) Save the remainder.	300
3) Multiply quotient by 64.	350-360
4) Subtract it from baseline.	410
5) Get the horizontal position.	420
6) If odd then add 1 to remainder.	450-460
7) Subtract position from origin.	500
8) Convert remainder to a bit position.	520-580
9) Is it already a graphics location?	590
10) If not then set bit 7	610
11) And reset bit 5	620
12) Put the information on the screen.	640
13) Check to see if finished.	690
14) Get the next variable	200
15) And carry on!	

Most of the other operations in the program are concerned with setting up registers prior to the above or with loop counting. In the TRS80, if a machine code routine has been called from BASIC then a RET instruction will return control to the next BASIC statement.

The information for the graph plot is stored in an integer array as a set of values between 0 and 40. This is rather wasteful of space since each element of the array is contained in two bytes and only the least significant byte is being used. It does make life easier, though, when filling such an array in BASIC.

The code shown is relocatable, that is, it doesn't mind where it is loaded in memory. This is achieved by avoiding references to absolute addresses within the program, in other words, any jumps or branches are specified as forwards or backwards relative to the current position in the program.

The BASIC Program

I will describe the program line by line, so treat this section as a set of extended REM statements.

40 GG%(N) is an array where I decided to store the machine code subroutine, it could just as well be put in reserved memory by POKEing the DATA statements. DD%(n,m) is the "target" array. The program treats this as a list of m arrays each of single dimensions and displays them in quick succession, giving the impression of movement.

50-100 These DATA values represent the subroutine, a program to generate such DATA statements automatically will be found in CT Sept 1980.

110 It sometimes happens that there are several groups of DATA statements

in my programs. I always start them with a 255 and end them with a series of 0's. This avoids having to be too precise about numbers of READs. Just laziness really and not necessary here. The first number in line 50 then, is a dummy number; take it out if you are not going to use line 110.

140-160 A way of getting the right bytes in place in the integer array. If you are POKEing the subroutine then you don't need this.

190 Lets you know something is happening, see line 220. The following lines are included as a simple example to get you started. You will, of course, wish to be more adventurous.

200-230 Now go and have a cup of coffee. "What!", I hear you say, "This was supposed to be a fast graph plotter!" Well the plotting *IS* fast, but the values to be plotted are still computed in poor old BASIC so it will take some time to fill the array DD% with 1200 values, especially if complicated functions are used. Line 240 causes the program to wait for you to get back from coffee!

260 This is it! The first statement on this line is a DISC BASIC feature and it tells the computer where to go to start the machine code subroutine. I have put it just before the USR call because when machine code is stored in array variables it can get shuffled around as the BASIC program excecutes, so the entry point needs to be updated before each USR call. The variable used on this line (X9) must have been previously allocated for a similar reason. These problems do not arise when the code is stored in reserved memory and the DEFUSR statement *could* go just after the DATA read section to be excecuted once only. The next statement on this line, USR, passes the LOCATION of the start of the array not the plotting subroutine so that it knows where to go to get the element values. The USR statement also passes control to the subroutine.

In Level II BASIC the entry point definition is more cumbersome, you will have to POKE values corresponding to the entry point into location 16526D and 16527D. Read the article in CT July 1980 for more details of how to do this.

300 Loops back round to give a continously moving display.

```
                    010 ;*********GRAFIC 1.4
                    020 ;GRAPH PLOTTER
                    030 ;THIS PROG INTENDED FOR USE AS A
                        RELOCATABLE
                    040 ;USR CALL FOM BASIC. IT WILL RESPOND
                        TO
                    050 ;0<=A<40, VALUES OUTSIDE THIS RANGE
                        WILL
                    060 ;NOT CAUSE A CRASH BUT WILL BE
                        IGNORED
                    070 ;HL MUST POINT TO THE FIRST ELEMENT OF
                    080 ;A 120 ELEMENT INTEGER ARRAY
                    090 ;Y=0 CHR POSITION 4
                    100 ;Y=119 CHR POS. 63
                    110 ;X=0 IS ON LINE 13
                    120 ;X=39 IS ON LINE 2
BF00                130          ORG 0BF00H   ;SOMEWHERE TO
                                                ASSEMBLE IT
0A7F                140 GETHL    EQU 0A7FH    ;GET USR ARG INTO
                                                HL
0078                150 XAXIS    EQU 120      ;NO. HORIZONTAL
                                                POSITIONS
3F7F                160 ORIGIN   EQU 3F7FH    ;BYTE
                                                DISPLACEMENTS
                    161                       ;CALCULATED FROM
                                                HERE
BF00  CD7F 0A       170 START    CALL GETHL   ;HL POINTS TO
                                                ARRAY(0)
BF03  06 78         180          LD B,XAXIS
BF05  0E 00         190          LD C,0       ;FOR SBC LATER
BF07  7E            200 LOOP0    LD A,(HL)    ;GET ARRAY BYTE
                                                INTO A
BF08  E5            210          PUSH HL      :SAVE FOR NEXT TIME
BF09  C5            220          PUSH BC      ;SAVE IT FOR LOOP
                                                COUNT
BF0A  FE 28         230          CP 40        ;ARG>40 OUT OF
                                                RANGE?
BF0C  30 3C         240          JR NC,LOOP4  ;YES SO SKIP THIS
                                                ONE
BF0E  06 FF         250          LD B,OFFH    ;-1 INTO B
BF10  04            260 LOOP1    INC B
BF11  D6 03         270          SUB 3        ;SUCCESIVE
                                                SUBTRACT
BF13  FE 28         280          CP 40        ;DIV BY 3 ROUTINE
BF15  38 F9         290          JR C,LOOP1   ;ON EXIT
                                                B=QUOTIENT
BF17  2F            300          CPL          ;TO MAKE 2>=A>=0
                    301                       ;A CONTAINS
                                                'REMAINDER'
BF18  68            310          LD L,B
BF19  26 00         320          LD H,0       ;PREPARE FOR *64
BF1B  CB 27         330          SLA A
BF1D  06 06         340          LD B,6       ;FOR LOOP 2
BF1F  29            350 LOOP2    ADD HL,HL    ;MULT. BY REPEATED
BF20  10 FD         360          DJNZ LOOP2   ;ADDITION
BF22  E5            370          PUSH HL      ;2 [6*HL
BF23  C1            380          POP BC       :HL INTO BC
BF24  21 7F 3F      390          LDHL,ORIGIN  ;CALCLATE SCREEN
                                                ADRESS
BF27  B7            400          OR A         ;CLEAR CARRY FLAG
BF28  ED 42         410          SBC HL,BC    ;GET VERT POS.
BF2A  C1            420          POP BC       ;GET AXIS COUNT
BF2B  C5            430          PUSH BC      ;SAVE BC FOR DJNZ
                                                LATER
BF2C  CB 38         440          SRL B        ;B/2 FOR X-AXIS POS
BF2E  38 01         450          JR C,LOOP3   ;ODD OR EVEN?
BF30  3C            460          INC A        ;PIXEL ALIGN
BF31  48            470 LOOP3    LD C,B       ;FOR 16 BIT SBC
BF32  06 00         480          LD B,0       ;GET IT RIGHT WAY
                                                ROUND
BF34  B7            490          OR A         ;CLEAR CARRY FLAG
BF35  ED 42         500          SBC HL,BC    ;FOR HORIZ, POSITION
BF37  47            510          LD B,A       ;FOR LOOP5
BF38  04            520          INC B        ;BECAUSE DJNZ DECS
                                                B EACH
                    521                       ;PASS IN LOOP5
BF39  AF            530          XOR A        ;XOR WILL ZERO A
BF3A  37            540          SCF          ;PUT 1 IN CARRY TO
                                                SHIFT
                    541                       ;INTO A AT LOOP5
BF3B  17            550 LOOP5    RLA          ;MOVE THE BITS TO
                                                THE
                    551                       ;CORRECT PIXEL
                                                POSITIONS
BF3C  10 FD         560          DJNZ LOOP5   ;THIS MANY SHIFTS
                                                NEEDED
BF3E  47            570          LD B,A       ;PUT RESULT IN B
BF3F  7E            580          LD A,(HL)    ;GET DISPLAYED BYTE
BF40  CB 7F         590          BIT 7,A      ;IS IT GRAPHICS?
BF42  20 04         600          JR NZ,SET    ;IF SO SET IT
BF44  CB FF         610          SET 7,A      ;IF NOT MAKE IT
                                                GRAPHICS
BF46  CB AF         620          RES 5,A      ;NON-GRAPHICS
                                                SPACE=20H
BF48  B0            630 SET      OR B         ;PUT THE EXTRA BITS
                                                IN
BF49  77            640          LD (HL),A    ;DISPLAY THEM
BF4A  C1            650 LOOP4    POP BC       ;RESTORE AXIS
                                                COUNTER
BF4B  E1            660          POP HL       ;FOR ARRAY COUNT
BF4C  23            670          INC HL       ;TWICE BECAUSE 1
                                                INTEGER
BF4D  23            680          INC HL       ;ARRAY
                                                ELEMENT=2BYTES
BF4E  10 B7         690          DJNZ LOOP0   ;MORE X-AXIS?
BF50  C9            700          RET          ;BACK TO BASIC
```

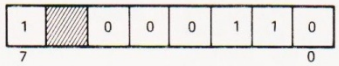
FAST PLOTTER

Using The Program

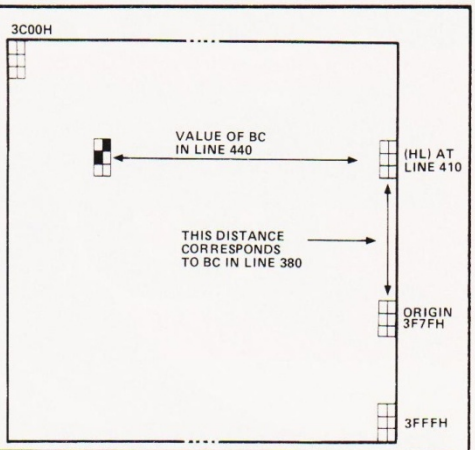
Type in the BASIC listing and RUN it! This will give you an idea of the speed of plotting, each frame seems to appear instantly. Now try various functions on line 220. Remember, you have two independent variables to play with, I2 and I1. Line 260 can appear anywhere in your own program as many times as you wish, so there is plenty of scope for experiment.

For example, a program could be written to alter a few of the target array elements while it is running, maybe under keyboard control. This could give a moving display which also changes over a longer time period.

This diagram shows how the byte position is calculated in the plotter subroutine (line numbers refer to the assembly listing). In this example graphic characters B and C are shown turned on, this means that bits 1,2 and 7 are logic '1' in that location. The byte will look like this:



This represents a Hex value of 86H(or 134D).



Program Listing

```
40   DIMGG%(41),DD%(120,10)
50   DATA255,205,127,10,6,120,14,0,126,229,197,254,40,48,60,6,255
60   DATA4,214,3,254,40,56,249,47,104,38,0,203,39,6
70   DATA6,41,16,253,229,193,33,127,63,183,237,66,193,197,203,56
80   DATA56,1,60,72,6,0,183,237,66,71,4,175,55,23
90   DATA16,253,71,126,203,127,32,4,203,255,203,175,176,119,193
100  DATA225,35,35,16,183,201,0,0,0,0,0
110  READ G9:IF G9<>255 THEN 110
120  FOR X9=0 TO 41
130  READ Y9:READ Z9
140  X8=256*Z9+Y9
150  IF X8>32768 THEN X8=X8-65536
160  GG% (X9)=X8
170  NEXT X9
180  **REM END OF DATA READ
190  CLS:PRINT@512,"DATA READ COMPLETE, FILLING ARRAY
200  FOR I1=0 TO 10
210  FOR I2=0 TO 120
220  DD% (I2,I1)=SIN(I2/20+I1/1.57)*19+20
230  NEXT I2,I1
240  CLS:INPUT"PRESS ENTER FOR DISPLAY";D
250  FOR I2=1 TO 10
260  DEF USR3=VARPTR(GG%(0)):X9=USR3(VARPTR(DD%(0,
     I2)))
270  FOR X=1 TO 50:NEXT:REM**IF YOU WANT TO SLOW IT
     DOWN!
280  CLS
290  NEXT I2
300  GOTO 250
```

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65p

LIVING IN BABEL?

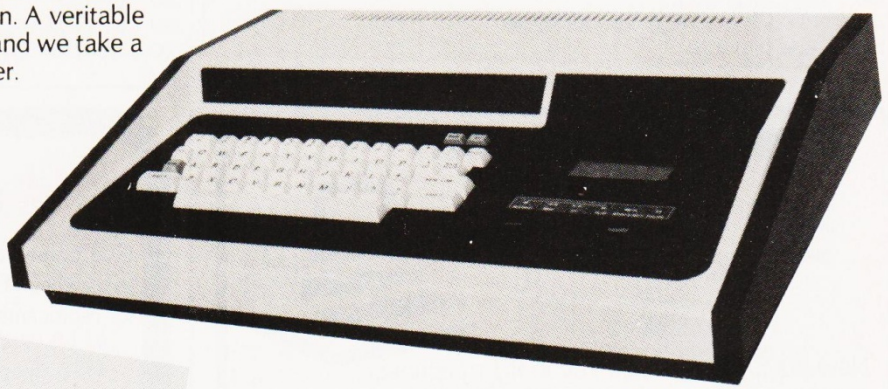
With the ever increasing family of computer languages to contend with we decided to start taking a look at some of the most important ones for the micro user. Just what they do and why one does it better than another are the sort of questions we'll be trying to answer over the next few issues. We start with COMAL, the newest recruit onto the micro scene.

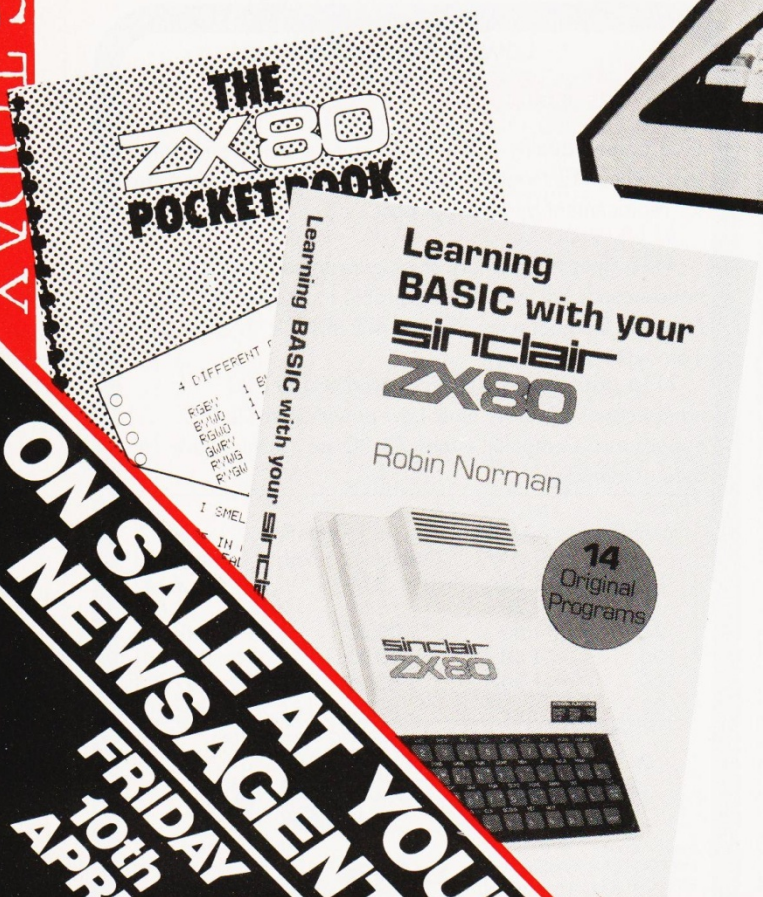
BINDING IT TOGETHER

Many computers seem to lack sufficient documentation and, unfortunately, the ZX80 is no exception. A veritable library seems to have sprung up around it and we take a look at some of the best, and worst, on offer.

CONQUERING EVEREST FOR FUN

Computer games often take real-life events and mimic them in miniature. This example is more than just a game, it's a complete simulation of an attempt to climb Everest, down to the last oxygen cylinder and footsore Sherpa. Can you plan far enough ahead to cope with sudden changes in the weather or will you risk all in a quick dash for the summit? It calls for strong nerves and a clear mind but will fit into just 8K of RAM, how's that for good planning?





GETTING OUT AND ABOUT

So you want more I/O than your computer is provided with? Well, you might actually have more than you thought in the first place. We show you how to increase the power of your PIO in easy practical steps. Any computer with a parallel port qualifies for this improvement.

A LITTLE BIT OF MAGIC

Following in the footsteps of the successful TRS-80 came the Video Genie system. Now, however, it may well have taken a step or two ahead of its American cousin by going all multicoloured. We sent in our expert to have a look and his report on this low-cost colour graphics machine makes very interesting reading for anyone thinking of taking the Eastern path to computerisation.

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74122	48p
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74125	75p
74126	60p
74128	75p
74132	75p
74136	75p
74137	50p
74141	50p
74142	200p
74145	90p
74147	190p
74148	150p
74150	130p
74151A	70p
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74154	120p
74155	90p
74156	90p
74157	70p
74159	190p
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74161	100p
74162	100p
74163	100p
74164	120p
74165	130p
74166	120p
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74LS30	20p
74LS32	27p
74LS33	27p
74LS37	30p
74LS38	38p
74LS40	25p
74LS42	70p
74LS47	75p
74LS51	24p
74LS55	30p
74LS73	50p
74LS74	27p
74LS75	36p
74LS76	45p
74LS83	70p
74LS85	80p
74LS86	40p
74LS90	40p
74LS92	70p
74LS93	60p
74LS96	110p
74LS107	45p
74LS109	80p
74LS112	40p
74LS113	90p
74LS114	45p
74LS122	80p
74LS123	60p
74LS124	180p
74LS125	50p
74LS126	50p
74LS132	60p
74LS133	30p
74LS136	55p
74LS138	65p
74LS139	75p
74LS145	120p
74LS147	220p
74LS148	175p
74LS151	80p
74LS153	60p
74LS154	200p
74LS155	60p
74LS156	90p
74LS157	60p
74LS158	60p
74LS160	90p
74LS161	75p
74LS162	140p
74LS163	85p
74LS164	90p
74LS165	140p
74LS166	180p
74LS173	110p
74LS174	100p
74LS175	100p
74LS181	320p
74LS190	100p
74LS191	100p
74LS192	100p
74LS193	100p
74LS194	100p
74LS195	140p
74LS196	120p
74LS197	90p
74LS221	120p
74LS240	175p
74LS241	175p
74LS242	170p
74LS243	170p
74LS244	150p
74LS245	250p
74LS247	140p
74LS251	140p
74LS253	90p
74LS257	90p
74LS258	160p
74LS259	160p
74LS266	100p
74LS273	170p
74LS279	90p
74LS283	90p
74LS298	160p
74LS299	375p
74LS323	400p
74LS324	200p
74LS348	200p
74LS365	48p
74LS367	70p
74LS368	100p
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Ian Sinclair

ATOMIC RESEARCH

An in-depth probe into the increasingly popular ATOM. Does its language impediment really matter? Read on and find out.

I first saw the ACORN ATOM in operation early in 1980, and I was impressed with the speed at which the programs ran, and its excellent graphics commands. I was also impressed with the way in which the basic unit could be expanded onboard without having to buy expensive add-ons, because, to my mind, this is the feature which distinguishes the genuine baby computer from the throw-away toy.

When my ATOM kit arrived in September, I tore into the construction with considerable glee, and a record of my progress through both hardware and software may be of some interest. To keep the record straight, I have always maintained that computer kits are never particularly good value for money compared to the same computer in ready-to-go form, and that the small extra price asked for a fully assembled and tested item is always worthwhile. I still hold to that view, but I must admit that the ATOM kit was very well thought out, with a clear constructional guide. Everything, in fact, had been done to make construction easy, even for a relative beginner (after 35 years, I don't quite qualify there). The PCB in particular is an excellent piece of work, silkscreened with component outlines and part numbers, and with all the tracks, apart from mounting pads, coated with insulating varnish to prevent short circuits caused by splashes of solder.

I started assembly one Saturday morning with a new bit on the excellent little iron I use for all my constructional work, and the bit was all but gone by the time the last joint was made! Computer construction involves a lot of soldered joints, and wears out a lot of bits if you use ordinary 60/40 alloy!

Getting back to the kit, all the ICs, with the exception of the voltage regulators, are in sockets, so that soldering can be done using an unearthed iron. Some of the holders were on the tight side, so that plugging in the ICs later was not always easy — I would recommend any constructor to ease up all the socket holes of the holders with a needle or an old IC before putting in the delicate devices such as the 6502, the 8225, and the 2114 memory chips. Only about half of the board is actually populated with chips when the basic model is being built, but all the holders should be put in as this makes expansion so much easier — just a matter of plugging in more memory chips.

The most difficult part of assembly is the attachment of the keyboard. The keyboard connections are made through rather fine but springy wires which protrude a short distance beyond the underside of the keyboard. Each one of these has to be persuaded to pass through a generously-dimensioned hole in the PCB and, when all are in place, soldered to the rim of each hole. This is by no means easy, and I would very much have preferred a plug-and-socket arrangement, particularly in view of the fact that my keyboard developed a sticking key.

Up And Running

Sunday morning was switch-on day, and the portable telly was hooked up, turned on, and the ATOM attached. The ATOM uses an external transformer/rectifier unit which plugs into the board via a socket of the type used on some pocket calculators. The contact seemed rather dodgy to me, though it hasn't given any trouble except when the unit is shifted while working; on the whole I would have preferred a DIN type plug and socket for this task. Alas, though the screen filled with characters when switched on, indicating that life was present, the characters didn't clear when the BREAK key was pressed, revealing something fishy in the chips. Good as their word, though, Acorn sorted this out, along with the sticky key, at no charge.

Before we finally leave the construction stage, there's one feature I moan about on virtually every computer kit I come across. The stabilised 5V supply is obtained from a 7805 on board, and the manual suggests that a heatsink (a small piece of aluminium is supplied) is needed only if the ATOM is expanded (to a molecule?). Now, I have endless trouble with 7805's, more than with any other chip, and the cooler they run the happier I am. Even with the aluminium attached, and no expansion, the 7805 in the ATOM runs hotter than I like, and I would feel inclined to use either an external power supply (which is provided for in the ATOM design), or to cut the case so that I could use a fairly substantial finned heatsink. As it happens, I intend to expand my ATOM, so I shall run it from the excellent (though well-used) power supply I bought from Display Electronics some time ago.

Circulating The Electrons

With all the hardware sorted out, and the cassette loading and dumping checked using the very useful diagnostic method shown in the manual, it was time to start investigating the programming of the ATOM. People who have read the manual will tell you that it is a very strange versions of BASIC. It is indeed odd, to such an extent that I, having written both a series and a textbook on BASIC, still have to refer to the ATOM manual when I program. As far as the beginner is concerned, however, *all* com-

puters are equally odd. The version of BASIC which is used by the ATOM is no more difficult (apart from string handling — see later) to learn than the Microsoft BASIC we all know and love — it's just different. There really isn't much point in simply saying that it's different without giving examples and looking at the reasons for the differences, so that the rest of this review will be devoted to a more detailed discussion of ATOM BASIC.

To start with, like the BASIC on several other very small computers, the ATOM BASIC is an Integer BASIC, which means that it doesn't handle fractions, decimal or otherwise. For many purposes this is unimportant to the beginner and the subject of using integers is well treated in the manual. It would be an obvious disadvantage for anyone who wanted to write programs for accounts, mathematical work or scientific analysis. As it happens, the ATOM would not be the best choice for anyone who intends writing such programs for a variety of other reasons, but an additional ROM chip can be added which provides a full range of mathematical functions, (see Tables 1&2) floating point arithmetic, (decimal fractions welcome) and colour graphics commands. Unfortunately, in order to make the expanded ATOM compatible with the unexpanded one, adding the extra ROM requires that some existing commands have to be altered to make use of the extra facilities. The alteration is the addition of F (for "floating") before some commands when the new ROM is to be used. For example, 'DIM' dimensions memory space for arrays or strings, but 'FDIM' has to be used for floating-point arrays. This example is fairly straightforward, but other commands such as 'FIF' and 'FINPUT' (floating-point IF and INPUT) are less so. Users who are not interested in the mathematical package need not worry about all this, and have the additional consolation that the ATOM will handle numbers between ±2 000 000 000 with complete accuracy, something that computers with floating-point numbers will not often do. The main point to remember with Integer BASIC is that divisions will give odd results because of the omission of the fractions.

The first instruction which figures prominently in any beginner's use of BASIC is PRINT and, on the face of it, the ATOM seems to use this in pretty much the same way as anything else, with a screen containing 16 lines of 32 characters each to print on. This apparent similarity is deceptive, however, because whereas on Microsoft BASIC, we need to use a command to get two PRINT statements on one line, the ATOM needs a command *not* to do this! For example, on my TRS-80, the commands:

```
10 PRINT "THIS IS"
20 PRINT "TRS-80"
```

will result in the output on the screen:

```
THIS IS
TRS-80
```

unless line 10 is written as: 10 PRINT "THIS IS"; ,using the semi-colon to indicate to the computer that PRINTing is to be continued on the same line. On the ATOM, lines such as:

```
10 PRINT "THIS IS"
20 PRINT " THE ATOM"
```

will print out as THIS IS THE ATOM unless a newline command (') is used, such as 10 PRINT "THIS IS" '. Note, incidentally, the space between the first quote mark and the T in line 20. If this space is omitted, then the T and the S of IS will be next to each other when PRINTed on one line.

To anyone brought up on Microsoft, this looks plainly perverse, but there is a very good reason for it which becomes apparent when you want to display tables on the screen. PRINTing, for example, 32 sets of numbers as four rows of eight columns is not completely straightforward with conventional BASIC, but on the ATOM it can be programmed by a line such as:

```
100 @ = 4 ;FOR N = 1 TO 32;PRINT
    AA(N);NEXT
```

The explanation for this is that @ = 4 sets up "fields" each of four character spaces, on the screen so that each number is fitted into a column. This allows a four character gap between the end of one column and the start of the next. The standard size, if we don't specify a value for @, is eight which gives us four columns. Using @ = 4 produces eight columns (with 32 characters per line there can only be eight lots of four), and the PRINT arrangements of the ATOM will therefore put the numbers into eight columns, printed in order to give four rows. No TAB command exists though there is a COUNT statement which keeps check of the numbers of characters which have been printed in a line. COUNT has to be used if the number of columns that you want to use will not divide into 32.

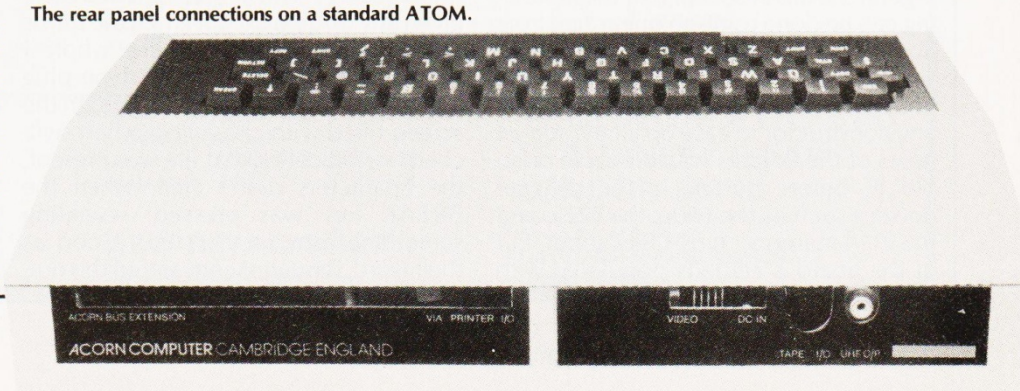
I have gone over the PRINT instruction in detail because it is the sort of difference between ATOM BASIC and Microsoft BASIC which could trip up even experienced programmers, although it is probably an advantage for the beginner who wants neat tabulation. No-one should have any difficulties over commands which are unique to the ATOM, because they are just new commands which can be learned, as we all have to learn new BASIC commands from time to time. The commands that are likely to give problems, mainly to people like me who may be programming different types of machine in the course of one day, are the ones which look like Microsoft BASIC but aren't, and those which look like nothing else on earth!

The Old And The New

Let's look at some examples. There's a command, OLD, which, when executed restores a program which had been NEW'd out. This is a command I would have given two ears and a tail for in the small hours of the morning when using some other machines. Provided that there was a program in the machine, and you haven't LOADed in another one (from cassette or keyboard), OLD will restore your program. Incidentally, if a program is stopped by using the ESC key, it will LIST normally, but if it is stopped by the BREAK key, it will not list unless the OLD routine is used first.

Other examples of "new" commands which are a useful enhancement of BASIC are the DO . . . . UNTIL loop, and the PLOT, MOVE and DRAW instructions. The DO . . . . UNTIL loop is a command which hasn't appeared on any other BASIC that I know of, but which is an essential part of Pascal and other structured languages. Its advantage is that it provides a neat solution to the problem of an indefinite loop, which has no satisfactory counterpart in ordinary BASIC. Suppose, for example, that we want to set up a number of subscripted variables, but we are uncertain of the

The rear panel connections on a standard ATOM.



number we need when the program is written. In conventional BASIC, we might write program sections such as:

```
10 N=1
20 INPUT A(N): IF A(N) = 0 THEN 40
30 N = N+1:GOTO 20
40 [next step after completing entry of
   array]
```

which needs two GOTO steps. As an alternative, we could use:

```
10 FOR N = 1 TO 100 : INPUT A(N)
20 IF A(N) = 0 THEN N = N-1 ELSE NEXT
   N
30 [next step]
```

which looks neater, but commits the sin of jumping out of a FOR. . . . . NEXT loop before the full allocation of steps (set at a maximum of 100 in line 10) has been performed. Not all versions of BASIC will allow this (because of the return address on the stack), though the TRS-80 is quite happy to permit such messy programming.

Using the DO. . . . . UNTIL instruction, we can write lines such as:

```
5 DIM AA(100)
10 N=0; DO N=N+1;INPUT A;
   AA(N) = A
20 UNTIL A=0;N=N-1
```

which permits much neater programming of loops which have to be terminated at some count number or by some condition such as zero entry. Note, incidentally, that in ATOM BASIC, INPUT cannot be used to enter items into an array — a dummy variable has to be used, A in this example. In addition, each array has to be dimensioned.

Graphic Illustrations

The PLOT, DRAW and MOVE instructions are a gift for the keen graphics user and games nut. The PLOT instruction is a complicated one which has to be followed by three numbers, separated by commas. The first number is the one which demonstrates what the PLOT instruction will do — move the cursor position, draw a line, draw black on white or white on black, plot a point, etc. Using the PLOT command effectively needs a lot of experience, and a copy of the PLOT commands pinned up on the wall, but it permits a remarkable number of interesting graphic commands. The MOVE and DRAW commands are, in fact, simpler versions of PLOT which carry out one PLOT function each. MOVE means 'move a cursor (not visible) to a position on the screen', and DRAW means 'draw a white line from the position set by MOVE to a new position'. To determine positions, two numbers, X and Y are used as co-ordinates. The number X is a distance in units across the screen, with X=0 at the left-hand side; for the unexpanded ATOM, the maximum value of X is 64. The Y number measures distance up the screen (Y=0 at the *bottom* of the screen) and on an unexpanded ATOM this has a maximum value of 48. A fully expanded ATOM with high resolution graphics permits maximum values of X=256 and Y=192. These same co-ordinates are the two other numbers which are used for the PLOT command. Note that unless these commands are preceded by CLEAR 0 (on an unexpanded ATOM), the computer will 'lock up', and the BREAK key has to be used. The CLEAR command prepares the computer for graphics use, and must be followed by a number which specifies the resolution of the graphics.

Another addition is the use of lower-case letters (typed a, b, c etc in text, but appearing on the screen as inverted upper case, (black on white) to indicate where a GOTO or GOSUB is to go. The use of such labels speeds up transfers, but there seems little real justification for the facility.

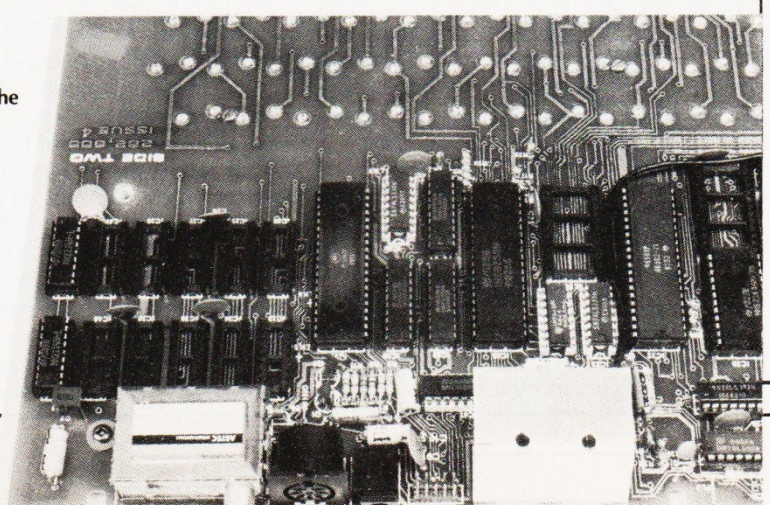
The troublesome commands for experienced programmers are the ones they will use instinctively — and therefore get wrong. The use of the single quote mark in PRINT statements is one good example of this, the use of '?' is another. Users of Microsoft BASIC in all its varieties are by now pretty well accustomed to finding that '?' has the same effect as PRINT, and is one of the few abbreviations that most computers do support. You can forget that one when you use the ATOM, because '?' is the command that replaces Microsoft BASIC's PEEK and POKE. For example, PRINT?32768 will print the value of the byte in memory address 32768; we can specify Hex address numbers by preceding the number with the hashmark (#). If we use the command : ?32768 = 65 , this is equivalent to a POKE action, placing the byte with (decimal) value 65 into the address specified by the number before the equals sign. This is, in fact, a particularly neat way of implementing PEEK and POKE, and is, if anything, an improvement on other versions. Once you can stomach the use of the words "byte indirection" for this action, you will be well away.

Stringing It Along

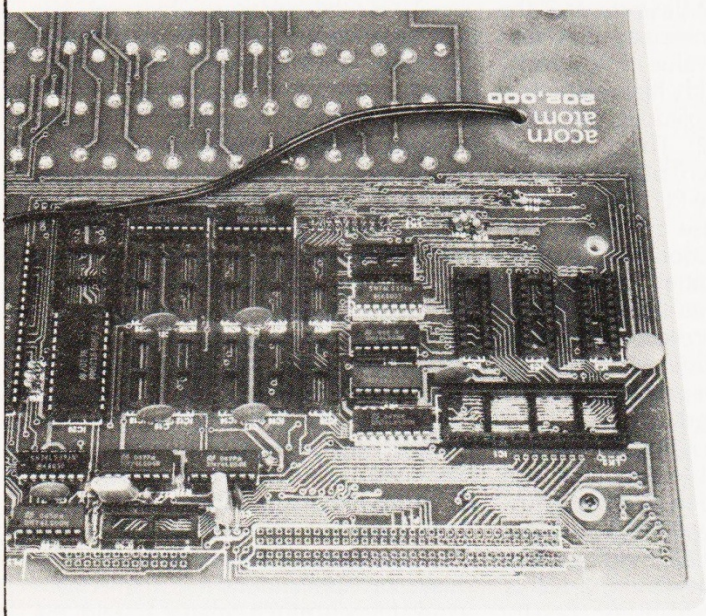
The most awkward problems are found in carrying out some procedures which, in Microsoft BASIC, are perfectly straightforward but in ATOM BASIC involve some very peculiar procedures. For some applications, including the very important educational market, this may rule out ATOM altogether. The "standard" computer for educational purposes is the RML 380Z, which uses several varieties of BASIC, all close to Microsoft standards. For my purposes, the string-handling commands of ATOM BASIC are the most off-putting — if these were reasonably normal, then the range of applications for the ATOM would be very much greater. Most of the programs which I write, either for my own pruposes or for education use, involve a lot of string handling. I am also unused to having to dimension the size of each string, neither the RML or my own TRS-80 require this, but I know that some computers do. The real problem is that the ATOM equivalents of the main string handling commands are of mind-boggling obscurity. For example, to join string B to the end of string A, we need the command: $A+LEN(A)=$B, which is not exactly so memorable as the Microsoft A$+B$. Right-string extraction, the command RIGHT$(A$,4) is, in ATOM BASIC, $B=$A+4, again not exactly memorable. LEFT$ is even worse — the LEFT$(A$,4) command in ATOM BASIC is $A+4="", and I challenge anyone to find a logical way of remembering that one! The MID$ command is simulated by combining the left and right extractions, and the example shown in the manual is:

```
10 $A = "ATOMBASIC"
20 $A+5="";$A=$A+1
```

which extracts TOMB. Certainly, once



The empty sockets behind the UHF modulator are for the high-res graphics. A total of 6K can be fitted.



Above: More empty sockets, this time it's the I/O and user memory. A total of 5K can be added to the existing 1K.

ABS (A.)	GOSUB (GOS.)	*PTR
AND (A.)	GOTO (G.)	PUT
BGET (B.)	IF	REM
BPUT (B.)	INPUT (IN.)	RETURN (R.)
CH	LEN (L.)	RND (R.)
CLEAR	LET (optional)	RUN
COUNT (C.)	LINK (LI.)	SAVE (SA.)
DIM	LIST (L.)	SGET (S.)
DRAW	LOAD (LO.)	*SHUT (SH.)
DO	MOVE	SHUT (SP.)
END (E.)	NEW (N.)	STEP (S.)
EXT (E.)	NEXT (N.)	THEN (optional)
*FIN (F.)	OLD	TO
FOR (F.)	OR	TOP (T.)
FOUT (FO.)	PLOT	UNTIL (U.)
GET (G.)	PRINT (P.)	WAIT

Table 1. ATOM BASIC commands, abbreviations in brackets. Those marked with an "*" are not available on the extended ATOM.

COLOUR	ABS	FLT (F.)
FDIM	ACS	HTN (H.)
FIF	ASN	LOG (L.)
FINPIT (FIN.)	ATN	PI
FPRINT (FP.)	COS (C.)	RAD
FPUT	DEG (D.)	SGN
FUNTIL (FU.)	EXP (E.)	SIN
STR	FGET	SQR
TAN (T.)	VAL (V.)	

Table 2. Extra commands available with the floating point ROM.

you get used to it, it's not as bad as it appears at first sight, but what on earth was wrong with LEFT$, RIGHT$ and MID$?

The statements READ and DATA which are usually among the first BASIC commands that a beginner learns in a computing course simply don't exist on the ATOM, and the methods which can be used to achieve the same effects are so complex that it's better to forget about this type of command altogether.

I must conclude, sadly, that if your interests are in string handling, the ATOM is not really a suitable computer to learn on, and you certainly could not transfer software from the ATOM to a 'conventional' computer. If, on the other hand, your interests are in graphics and games (and I suppose there are still some people interested in games) then the features of the ATOM may appeal very strongly. You have, after all, in the PLOT, MOVE and DRAW instructions, a set of graphics capabilities which would cost you a fortune on other machines (try asking the price of a 380-Z, for example) and, with a relatively simple low-cost expansion you can do high-resolution work.

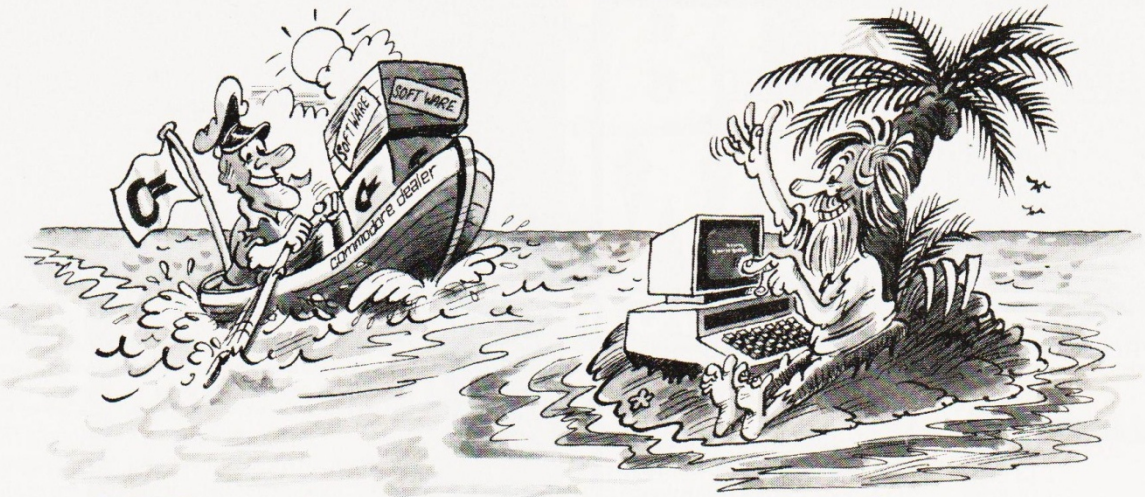
Before we leave the subject of BASIC programming it's worth looking at the way in which ATOM stores its BASIC instructions. The unexpanded ATOM stores its programs starting at address 33282 (decimal), and the form of the line is straightforward. The first byte or pair of bytes represent the line number, using the most significant byte first (omitted if zero). For example, line 10 appears as 10, but line 300 is stored as 01 44 (1 x 256 + 44 = 300). The instructions in the line appear in their ASCII code form, with a carriage return (ASCII 13) and a zero to mark the end of the line. The last line (END) is terminated by a carriage return (13), and the last two bytes are 255 164 end markers — these appear even if the END has been omitted.

The simple construction makes it very easy to synthesise or modify lines from a running program by POKEing values directly into memory (OLD then has to be used to ensure that the pointers are correctly set), but on the other hand, it is wasteful of memory. Microsoft BASIC, as used on TRS-80 and others, stores each BASIC command as a single byte. By not doing this, the ATOM can include a set of half-tone (grey) graphics, but on a machine which has such a small amount of memory (½ K unexpanded) in standard form, the ROM storage which would have been needed to produce the 'tokens' would surely have been worthwhile. When I first read the advertisements for a certain other computer announcing that it used single-byte command words, I wondered who they could possibly be getting at — now I know! In mitigation, however, it must be said that the ATOM method allows a printer to be interfaced without re-designing the ROM, and memory can be saved to a considerable extent, as on the old TRS-80 Level 1, by using the abbreviations.

Assembled Conclusions

Finally, a very potent reason for buying an ATOM is the least-expected one. The ROM includes a 6502 assembler, which permits assembly language instructions in mnemonic form to be typed in and assembled into machine code. I spend some of my time teaching 6502 programming using a KIM-1 so that the students have to assemble 'manually', and punch code in Hex. For very little extra cost, the ATOM would allow users to type in assembler language directly, with the added advantage of a very reliable cassette interface which really does work with low-price recorders. The provision of the assembler gives such an overwhelming advantage to the ATOM that I can see this as being a major market 'plus' for the machine — it is certainly one facility which will figure very largely in my own use.

To sum up, then, the ATOM is a strange mixture of a machine, designed with very few attempts for it to be compatible with other machines. Some of its features may make it almost irresistible to you — the excellent graphics, and the assembler are two particularly strong points. Other features, in particular the string handling, may make it rather unattractive. On the whole, it is never a boring machine to use, and the more I use it the better I like it. I greatly look forward to expanding the memory and adding some of the many standard ACORN interfaces.



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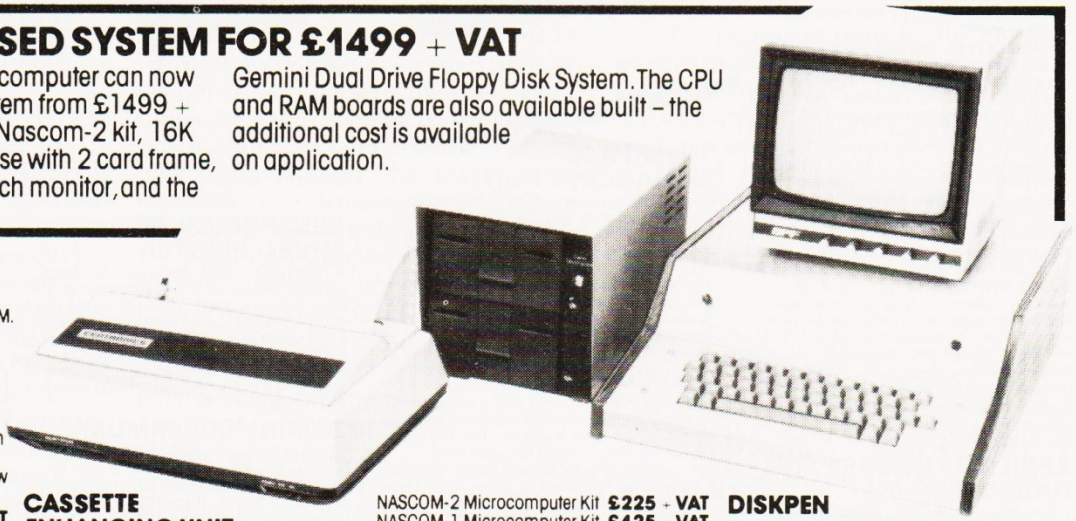

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Nascom-2 Single drive system. **£450 + VAT**
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Additional FD250 drives ..... **£205 + VAT**

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All prices are correct at time of going to press.

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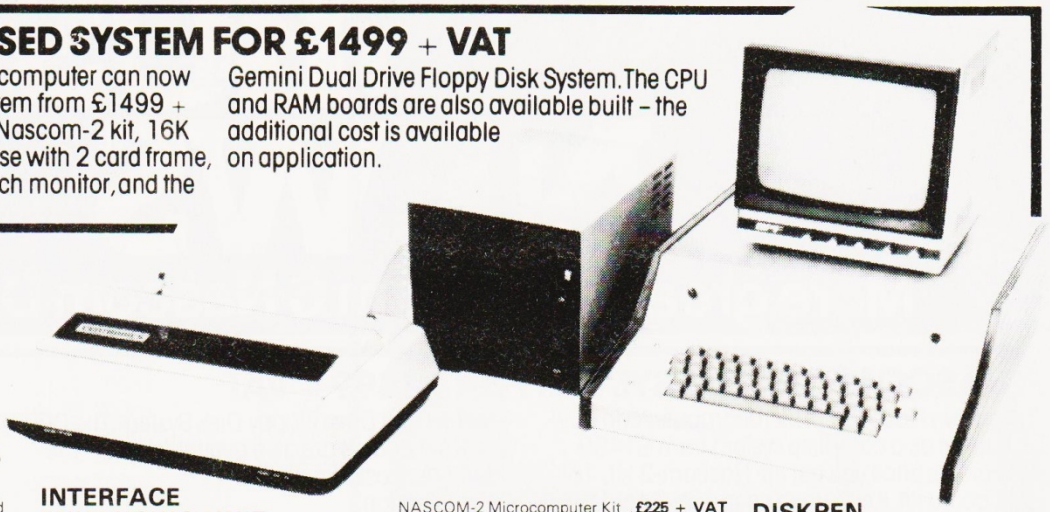

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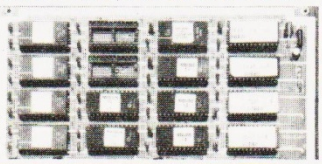

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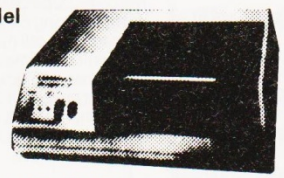

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DEATH AMONG DRAGONS

The quest to find the best fantasy games has begun. Join us on our epic journey.

Boris the Wanderer rode slowly between the lofty trees that cast pools of shadow, hiding all but little of their vast grey trunks. In the distance he could see a patch of sunlight that shone on a massive rock formation. As he rode closer he realised that this was what he had been searching for. Old Hubert the seer had told him that his guide on this penultimate part of his quest would be a giant red bear. The red sandstone picked out by the early morning sun had a striking resemblance to such a beast. Closer now to the rocks he could no longer see such a likeness but a darker shadow at the base of the rocks was surely not natural . . . a doorway to a mine or the entrance to some enchanted fairy hall . . . all he knew was that his many years of travel and searching had led him to this place at this time. Here would be enacted the crux of his existence. Many vague clues had brought him here, now, at last, he would learn the mystery of the smoky green globe swinging on its silver chain around his neck.

He dismounted and hesitated for a moment, what should he take with him into this strange place, his sword and armour of course. Would he be able to see far enough to use a bow? What about light and food? Should he take that strangely heavy talisman he had won from the black priests of Tûl, its potency as yet unknown? Was this the time for its use?

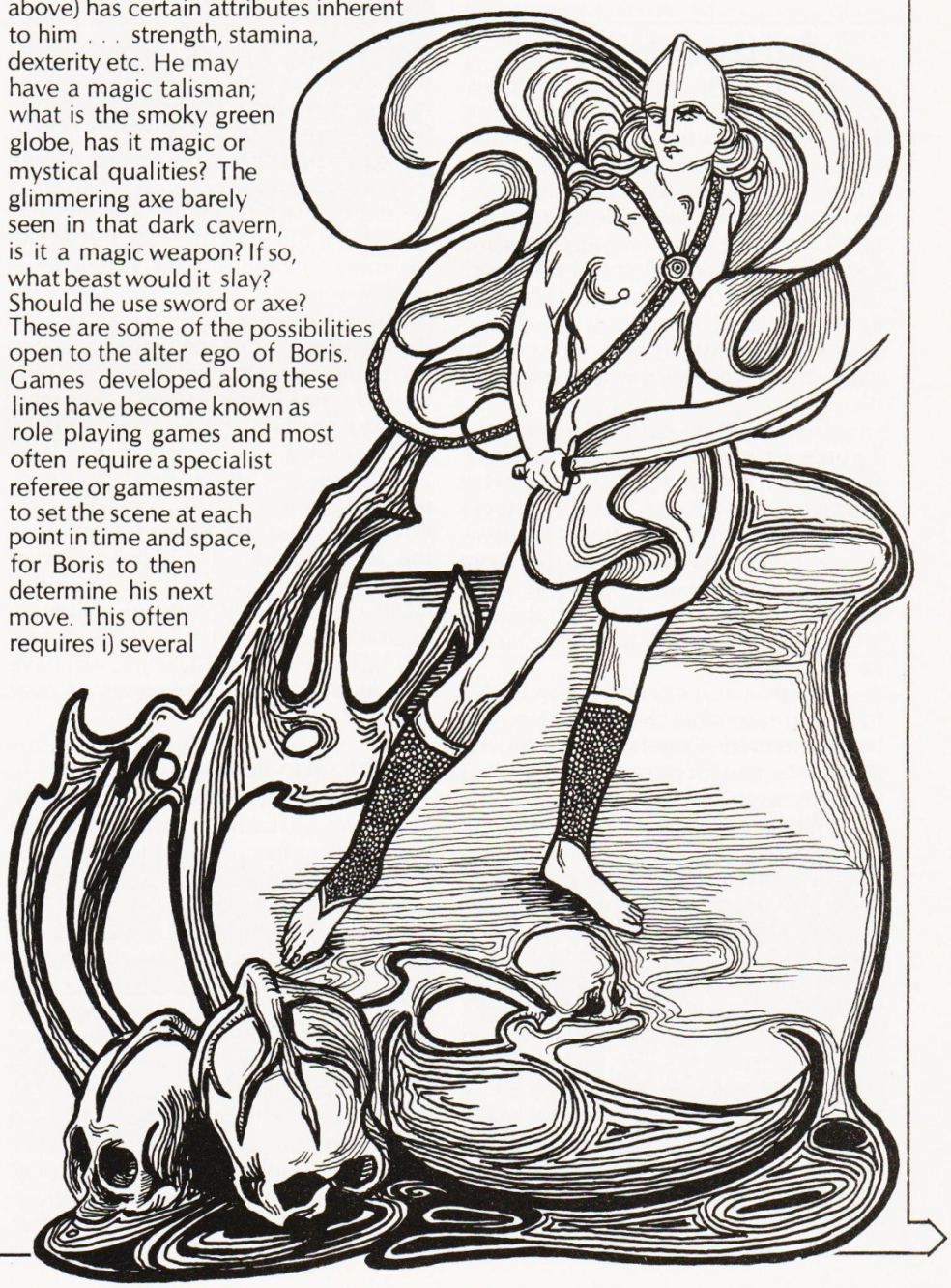
He strode along the entrance passage, a flaring torch held over his head. One hundred paces in, he saw proof for the first time of some other hand at work than Mother Nature . . . great iron doors were visible on either side of the passage. He leant towards one, listening carefully, no sound could be heard. Opening the door he quietly moved into the cavern beyond. He caught a glimpse of a glimmering axe hanging upon the far wall . . . before a screaming ululation momentarily turned his blood to ice . . . Sword in one hand, flaring torch in the other he prepared to fight for his life . . . . . .

Fantastic Adventures

Such could be the setting for an adventure in the land of fantasy, heroic deeds, magic weapons, spells cast against monsters of elsewhere: a saga of the hero questing after treasure, be it gold or mystical knowledge. Games involving these wide ranging rules have appeared in many guises in the last decade. Unlike the more formal and well known board games of yesteryear, these adventures usually allow the player more freedom of movement and more development of an individual character.

No longer trapped on a board with abstract counters, Boris (in the scene above) has certain attributes inherent to him . . . strength, stamina, dexterity etc. He may have a magic talisman; what is the smoky green globe, has it magic or mystical qualities? The glimmering axe barely seen in that dark cavern, is it a magic weapon? If so, what beast would it slay? Should he use sword or axe? These are some of the possibilities open to the alter ego of Boris. Games developed along these lines have become known as role playing games and most often require a specialist referee or gamesmaster to set the scene at each point in time and space, for Boris to then determine his next move. This often requires i) several dedicated people to band together to make the game a successful alternative reality, ii) a considerable amount of dice throwing to determine the random chance of monsters attacking or of treasure being found, iii) yet more dice throwing to decide the outcome of attack or the many-levelled value of a treasure.

The computer provides the natural gamesmaster, random numbers weighted by certain known characteristics are its natural prey! So too are the decisions as to what can be seen, heard or found. The computer can readily decide on a random or previously determined plan for the playing area and the distribution of treasures/monsters. With



its help you can not only adventure into unknown lands, but experience real time combat, the like of which will bring sweat to your brow and a heartfelt sigh of relief when you manage to crawl back alive to the reality we normally perceive as "everyday".

The First Experience

The first computer fantasy game played by the Modmags staff crossed our portals shortly before Christmas. Most of us knew of such beasts but had seldom actually met one. The "Halls of Death" came to us complete with instructions, cassette and a review of same from John Still of Wembley. Within minutes we had it LOADing, your editor at the keyboard, another staff member (later to be known as Conan!) quickly trying to absorb the instructions and two more would-be adventurers standing by to offer helpful suggestions in moments of crisis. Your editor came staggering out of the "Halls of Death" alive but bleeding some 15 minutes later — you really should read the instructions first! Real-time combat means just that — there is no time to look up which key you should press next when a "huge troll" is swinging his sword at you!

Having enjoyed our initiation to Fantasy Games with the "Halls of Death" we decided to put our heroes' lives at risk in some of the other exotic surroundings found in the software land of fantasy. Those readily available are:

1) Temple of Apshai (PET:32K; TRS:16K; Apple:48K disc)
2) Morloc's Tower (PET:32K; TRS:16K)
3) The Datestones of Ryn (PET:16K; TRS:16K; Apple:48K disc)
4) Sorcerer's Castle (PET:8K)
5) Jason and the Argonauts (PET:8K)
6) Halls of Death (PET:16K)

Numbers 1,2,3 above are from Automated Simulations, California and are available from ALGRAY:(TRS), ACT (Microsoft)LTD:(Apple and PET). Numbers 4 and 5 are Commodore software Treasure Trove No.8. Halls of Death is available from Supersoft.

TEMPLE OF APSHAI

This is the first in the Dunjonquest series of fantasy games by Automated Simulations (California, USA); it is an interactive role playing adventure game where the player starts by purchasing equipment for his quest. To do this he is given a meagre sum of silver pieces and then has to haggle with the "Innkeeper" over the price of arms and armour etc. Even if the Innkeeper is rude — persevere, it is worth the time spent to get even *one* extra arrow, you will need it!

The objective is now to enter the Temple (there are four levels of difficulty), explore the rooms, picking up what treasure you can and fight off attacks from various monsters along the way. You are only shown part of the room map at any one time, so you must remember which way you came! There are many secret doors to find and traps for the unwary.

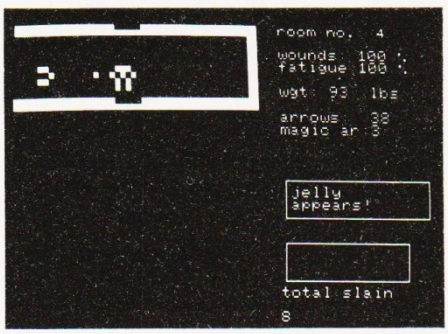
Should you be killed (fairly likely), there is a reasonable chance that you will be resurrected. Depending upon who resurrects you some or all of your treasure may be taken in payment.

Temple of Apshai comes to you as a cassette (or disc) and an attractive booklet containing instructions for play, a short history of the Temple, catalogues of the monsters to be found, treasures of each level, a descriptive list of all the rooms and a Master Treasure Key that gives the value in silver pieces of the various treasures. This last is important as the program only tells you that you have found "treasure #5" etc and you must keep a record of how much you have accumulated.

Playing "Temple of Apshai" on the PET starts with the LOADing from cassette of the main game program. On RUNning this you will be asked if you wish a new character generated, on the answer 'yes', the six primary characteristics: Intelligence, Intuition, Ego, Strength, Constitution and Dexterity are displayed together with randomly generated values for each, you will also be given a quantity of Silver Pieces. All this information has to be written down so that you may re-use the character in the future. Having finally got away from the Innkeeper with your 'hard bargained for' equipment, you will be asked "what level do you wish to visit?". You must take out the tape, turn it over to DATA FILES, rewind, enter your choice of level and, if you are lucky, the data will be read into your program. Unfortunately error messages are not uncommon at this stage. Should this happen: rewind the tape, type CLOSE 1, RETURN, GOTO1600, RETURN and you will again be asked "what level?". If you do not do this but simply type RUN you will have to haggle with the Innkeeper all over again!

Into The Temple

You are now in the first room, with luck there will be no monster in sight, so you can get the feel of the command keys. You may move forward 0-9 feet (keys 0-9). The further you move in one go the greater the drain on your fatigue points (reasonable!). You may turn left or right or turn round to face the other way. You may also key 'S' for "search for traps"; 'E' for "examine for secret doors" and several other commands (open doors, drink a healing salve etc). Should you meet a monster you may try to run away from it or you may fight. Fight sequences take place in real time and at the beginning of the game you are given the option of "slow, medium or fast monster speed?". The attack commands allow you to: normal attack, thrust, parry or fire an arrow (normal or magic). Thrusting takes more fatigue points, firing an arrow restores some of the fatigue points (as does "search", "examine" or any non or low movement command). Should you be wounded, then fatigue points are used up more quickly. Commands take a little while to be actioned and, as these are stored in the keyboard buffer, care must be taken to press the right keys at the right time! It is disconcerting to be advancing towards a monster when you really wished to fire an arrow, only to find you have overshot the monster and are firing an arrow at a blank wall! Meanwhile it is hitting you!



Our 'hero' (left) caught in the act of firing an arrow at the deadly jelly (!) at the right.

Although a fair amount of information is displayed on the screen, I wish I could fathom out the hitting power of i) Me and ii) the Monster! It is somewhat disturbing to be apparently attacking strongly with 69% wounds (100% = perfect health) and with one hit from the monster, the screen goes blank and "Thou art slain" appears!

On moving from one room to another the screen blanks and the next

portion of the room map is drawn on the screen; this is a fairly slow process but it does give you a few moments to gather your wits and assess the situation. If you have run away from a monster rest assured that it will probably be waiting for you on your return!

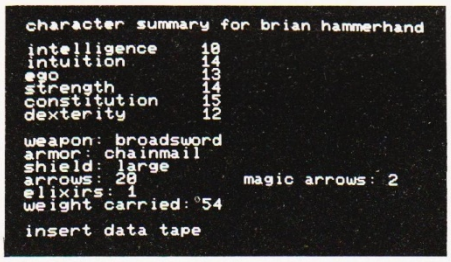
Summary

Temple of Apshai will give many hours of playing time, taxing your ingenuity to stay alive. It has a few points that weaken what could be a superlative adventure. Loading the cassette for each level together with possible load errors can be time consuming although, in fairness, the time spent playing far exceeds the time to enter data. Its slow reaction to some commands together with the storage of commands in the keyboard buffer is frustrating. Some obviously valuable treasures are not listed in the Master Treasure Key. The requirement to write down characters' attributes, treasure and experience points is disappointing in a game such as this, surely they could be stored in memory for any one game cycle and/or written as data to cassette or disc. This might also discourage the falsification of an individual's data!

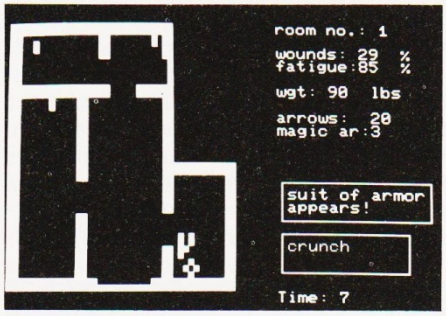
I would like to see a different weighting applied to the outcome of the fight sequences. This imbalance is surely borne out by the relative ease of death and resurrection. Even with these criticisms Temple of Apshai must remain, for a long time, the game others are judged against.

MORLOC'S TOWER

Morloc's Tower is the second fantasy game in Automated Simulations, Dunjonquest series, the scenario being a six floored tower in which is found the wizard Morloc, together with sundry monsters, and a selection of usable treasures. Scoring, in Morloc's Tower, is straightforward, slaying Morloc and staying alive are your most important objectives. The faster you slay Morloc and the longer you survive in the tower — the higher your score. The time you stay in the tower is recorded and this, together with the degree of difficulty you chose at the beginning of the game, determines your final score.



Character generation for your foray into the magical realms of Morloc's Tower.



The ground floor plan of Morloc's Tower. The character has just thrust and hit (crunch!) an attacking suit of armour.

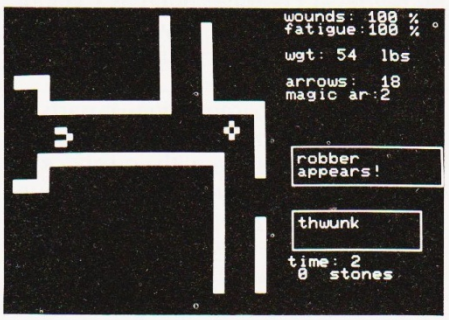
As with Temple of Apshai you get a cassette tape and an instruction booklet. You are asked "what level of difficulty do you want(1,2,3)?" and are then given a character armed and ready to do battle! The DATA FILES must now be loaded and having successfully done this you find your character on the ground floor of Morloc's Tower. The commands available and the information shown on the screen are similar to those in Temple of Apshai with the addition that certain treasures may be used during your quest (would you believe a magical hand grenade!). In general format the game is similar to Temple of Apshai, from which the program is derived, the scenario and the lack of choice in weapons being different. There is no resurrection routine, if you are killed — you stay killed! Also although there are only 30 rooms in the tower (compared to some 200 in Temple'), the traps and monsters may change position from game to game. The balance in the fight sequences appears to be more realistic, although I would still like to see some indication of relative strengths.

Altogether an enjoyable game (bearing in mind that the criticisms applied to Temple of Apshai run through the three Dunjonquest programs). Not so elaborate as Temple of Apshai but as a score is generated it can engender some keen competition amongst a group of players.

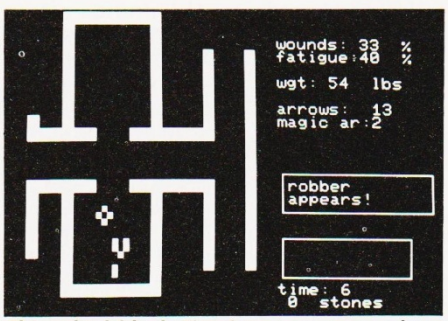
THE DATESTONES OF RYN

This is the third in the Dunjonquest series by Automated Simulations. In operation and display it bears a likeness to the two preceding games. The scenario is that a dastardly robber band, led by Rex the Reaver, has stolen the precious Datestones from the ducal calendar. Your mission is to recover the Datestones before Rex and his cutthroats can slip away. Once again the cassette program is accompanied by an attractive booklet containing instructions and a brief scenario.

Playing follows along the lines of Morloc's Tower with a character generated for you by the program, the aim being to enter the caves where the robbers have hidden the stones, fight the monsters and robbers, find the stones and exit before the 20 minutes allowed has expired. Should you be killed — you stay killed but if you managed to bring out any of the stones you are credited the score for these posthumously! Points are awarded for each minute you stay alive inside the caves, with an additional



So far, so good! You are still alive after two minutes and have just hit a robber (right) with an arrow (thwunk!).



Things look bleak. Six minutes are up, you have some treasure in sight (white rectangle) but you are wounded (33% wounds) and a robber has just appeared behind you.

bonus for being outside when the time limit is up. You also gain points for slaying your opponents — but only if you stay alive. Getting out with one or more stones is your main aim but should you find and kill Rex the Reaver, he is more valuable than any one stone!

The action commands are similar to Temple of Apshai and play suffers slightly for the same reasons. Also, loading the data files is left to your imagination as the program fails to instruct you when to do this! As a final score is generated there is no need to note the equipment issued or treasure gained.

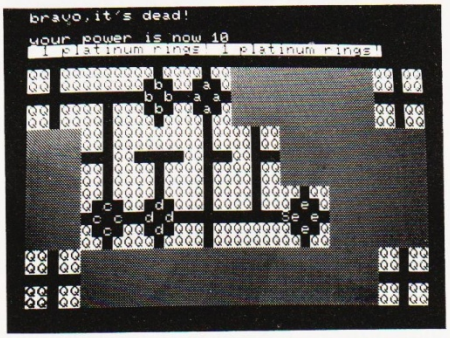
An entertaining game, the more so with the additional element of the fixed time limit.

SORCERER'S CASTLE

Although still available together with Jason and the Argonauts as Commodore Treasure Trove of Games No.8, this game is of the first generation of fantasy games and is far superseded by others now available. Sorcerer's Castle is a seven floored castle with an exit only on the ground floor. There are floors above and below the level at which you enter, and you may fall down or be catapulted up to other more dangerous levels. Each floor contains hidden and shifting passages, rooms and traps, and at any time a wandering monster may spring upon you and only by finding the magic (!) word may you escape. The rooms may contain treasures, monsters or nothing at all. Monsters may be friendly or aggressive and you may even meet the Sorcerer himself.

On loading the cassette and running the program you will be given several pages of instructions ending with the instruction to LOAD the game module. Having done this you are given a power value (randomly generated and can be disastrously low!).

The pattern for the ground floor of the castle is then drawn on the screen, you may move North, South, East or West. Only when you exit from a visible passage or room is the next block containing passages or a room shown on the screen. At random intervals you are beset by a wandering monster, you are then told you have 20 secs in which to find the right spell to bind the monster (keys A-Z), in reality you may key up to 20 letters regardless of time interval. If you manage to find the correct letter, you continue on your way; if not you are dead and have to start again. Should you enter a room and find a monster there, you are given the choice of fight, approach or withdraw (F, A or W). If you withdraw you get away but do not collect any treasure the monster may be guarding. You may only exit the castle from one of the four corners of the ground floor — which corner you do not know!



The ground floor plan of the Sorcerer's Castle. You have killed a Lurgi and are just collecting its treasure.

Summary

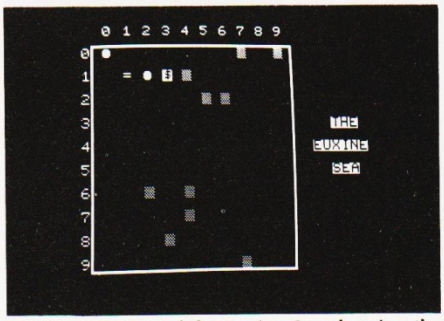
Although you have a number of commands at your disposal, direction of movement, fight, approach, withdraw etc, the feeling of player interaction is very low, all fight decisions seem to be random although your power value does play some part. The program tested seemed to have a few bugs, not the least its inability to erase some of the statements shown on the screen, notably those that run to two lines. Following this, a direction command could not be actioned until the offending additional line had been deleted. On the other hand some information, when erased, also erased the top line of the room plan! The keyboard buffer was never disabled so, after battling a wandering monster, you might find characters in the buffer that would subsequently give you the statement 'No Such Way'.

On the whole a boring game, with the feeling that one has little control over the outcome. Also poor programming to contend with, in addition to the monsters!

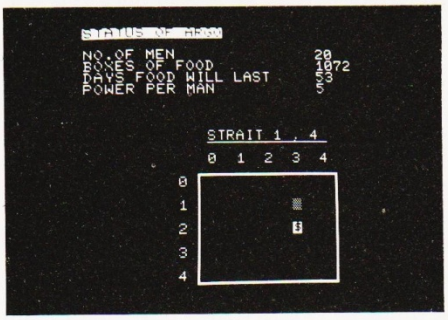
JASON AND THE ARGONAUTS

The second of Commodore's Treasure Trove of Games No.8, again a first generation fantasy game and as such not giving the player the interaction of later products. Based on the mythological adventures of Jason, the program sets you on a voyage across the Euxine Sea in quest of the Golden Fleece. The Fleece is hidden on one of numerous islands, all other islands being inhabited by mythical creatures such as Cyclops, Medusa, Circe etc. all of whom are bent on preventing the successful outcome of your journey.

The tape program is in two parts — instructions followed by the game program. The game starts with you choosing the number of your crew and the amount of food to load aboard (more crew eat more food — length at sea restricted, less crew — less fighting strength against the monsters!). You are then given an overall map of the Euxine Sea showing your position and all the islands. You may 'Sail' to any adjacent co-ordinate but having got to a co-ordinate containing an island you will be shown a larger scale map of that 'square' and must 'Row' across to the island. There are various hazards to beset you at sea — tidal waves, typhoons, sea monsters etc,



The overall map of the Euxine Sea showing the position of the Argo and the islands you may explore.



Large scale map with the Argo's crew rowing across to a nearby island.

DEATH AMONG DRAGONS

together with some more pleasant experiences — extra food, crew members, mermaids(!) and nibies(?!). Reaching an island inhabited by a monster, you must decide how many crew to pit against it — some are usually killed in the process.

This game proved quite enjoyable, albeit rather slow, and as Socerer's Castle, with little player interaction. The program is not foolproof and you must ensure that you are giving a valid command before pressing RETURN!

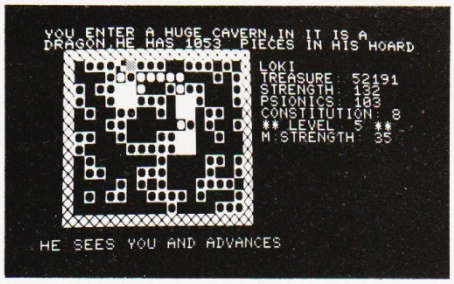
HALLS OF DEATH

This game is less complex than Temple of Asphai, with fewer commands available, but it is fast moving and exciting. The program will run on a 16K machine and is virtually crashproof. The scene is set with your hero entering level one of a six level series of rooms, on your first game with a new character you are given a limited number of strength and psionic (magic) points, these are augmented by finding 'magic swords' and 'helms of psionics'. There are a number of different types of monsters that may appear, and on meeting one you may be given the option of "Attack or Retreat", you must react quickly, if you think about this too long or press the wrong key, the monster will attack you. Should he hit you, your strength points will decrease dependent upon where he hit you (head, chest, legs etc.) You are then given the option "you may Swing, Retreat or use a Spell" again if you take too long, you will be told "you are too slow, he swings". If you had keyed 'S' for swing you may hit him or he may parry — the outcome is decided upon your relative strengths and where you hit him.

At first your fights may take some time to decide but as you get stronger (by finding magic swords), your strength will tell and you will finish off the monsters on level one more quickly — but beware: a badly wounded Kobold can still get in a lucky blow and cause you some damage! As you descend to the lower levels treasure becomes more valuable, magic swords give more strength and the monsters become more dangerous. It is wise to build up your character on the upper levels before seeking the greater treasure further down!

Throughout the halls are traps which may cause you to fall down one or more levels. From the second level down are teleportation rooms that can transport you to a different level. The walls are generated randomly so you could find yourself walled in and unable to reach the one and only 'stairs up' there is on each level.

During the combat phase you may attempt to retreat: you may get away, or be told "this is no place for cowards, he swings"! You may also use a spell (if you have enough psionic points). There are four spells available: i) Sleep, ii) Teleport, iii) Lightning Bolt and iv) Fireball. All may be used in combat and the last three at any time. You may teleport to any level and the lighting and fireball spells may be used to knock down walls, should you so require! Spells usually work but *not* always! You may change psionic points into strength points and vice versa, at an exchange rate of 3 to 1.



Two dragons have been vanquished in their lairs (large white blocks) but a third has smelt your blood!

The aim of the game is to stay alive(!) and find more treasure, the largest hoards of treasure are found on the 5th and 6th levels guarded by Dragons in their lairs. Apart from swinging at you like other monsters, these great beasties also have the nasty habit of breathing fire at you, needless to say, causing you a certain amount of damage! Also found on the lowest two levels are Wraiths, these may only be fought using magic and have the ability to drain away lots of your psionic points if they hit you. One of the most unpleasant creatures is the dreaded Mummy, some behave like the other monsters but a few have Mummy Rot(!); should they hit your head, you catch the rot and die regardless of how strong you are, unless . . . well, there is a chance that the Gods will intervene and let you carry on fighting. Beware too of overstaying your time 'down below', each time you venture down, you start with a fixed number of Constitution points, every time you kill a creature you lose one point. You may be lucky and find 'rings of stamina' but should your constitution drop below zero you die of nervous exhaustion!

Movement control is limited to one square (room) at a time (there are over 1000 rooms in all). On entering an unexplored room, a random number is generated and from its value is determined what, if anything, you will find in that room. Having once explored a room it will remain empty, although stairways down and possible traps will remain. Treasure points are gained by finding treasure and by killing monsters (especially Dragons). The number of treasure points you have, determines your rating. At the end of play when you stagger out from the Halls of Death you are given a list of the monsters you killed and your rating, there are 23 ratings from 'Apprentice Bumpkin' with less than 50 points to 'Ruler of Light' with over 100,000 points!

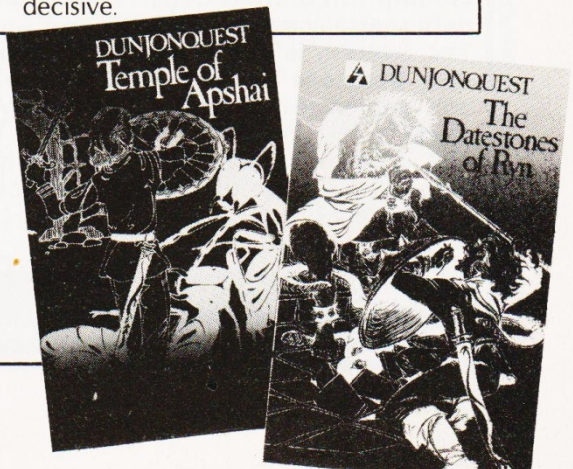
One excellent point is that this is the only game with the option of storing your character and all his points on tape, so that on your next adventure you start where you left off on your last. The program runs well and is very difficult to crash; commands are not stored in the keyboard buffer so action is quick and decisive.

And Finally . . . .

For a long term adventure (weeks!) Temple of Apshai (from £13:cassette, £23:disc) although fairly slow to play offers the most variation and difficulty to stay alive. Morloc's Tower (£11:cassette) is good fun but loses its appeal after repeated playings but as with Datestones of Ryn (£11:cassette, £13:disc) it has a great attraction if played competitively within a group of players.

Halls of Death (£14:cassette) is by far the fastest moving and will have your palms sweating and heart pounding time after time, it also has the advantage of a stored character and rating that you may improve over a long period.

Sorcerer's Castle and Jason and the Argonauts (£10:cassette) are really not in the same league as the others and are hardly worth buying.



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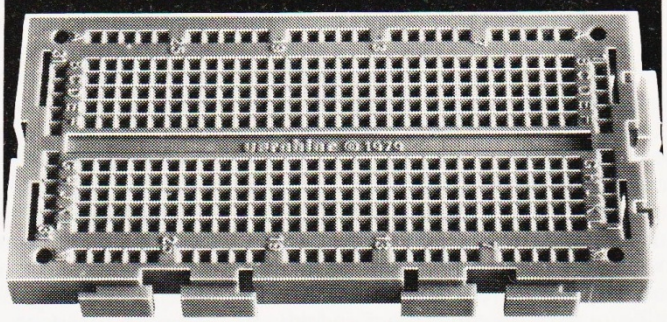

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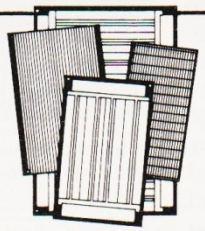

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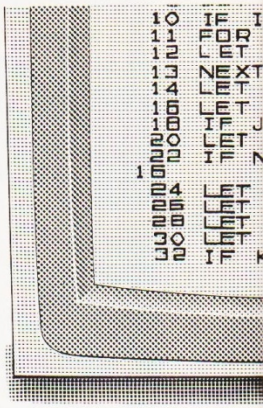

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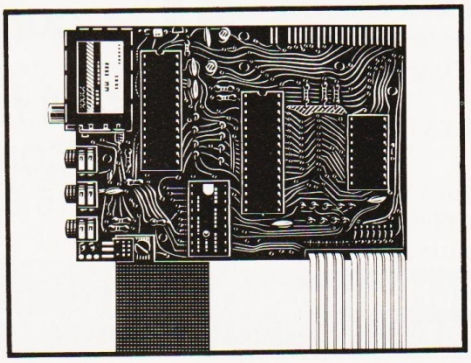

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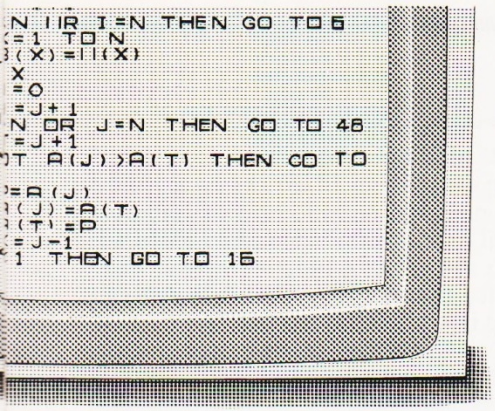

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- Able to drive the new Sinclair printer (not available yet – but coming soon!)
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sinclair ZX81

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Reg. no: 214 4630 00

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	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(s).	18	49.95	
	8K BASIC ROM to fit ZX80.	17	19.95	
			TOTAL: £	

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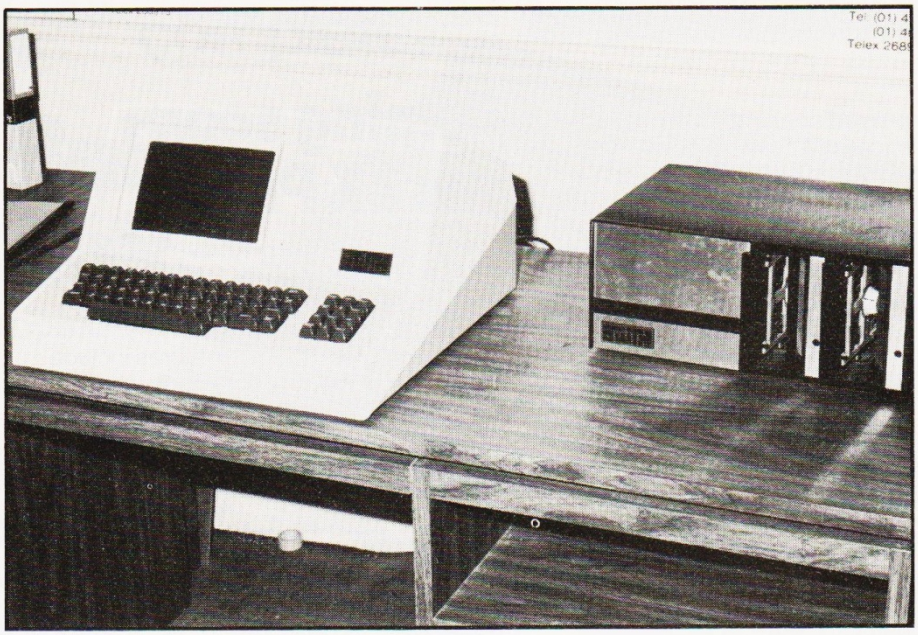
Mike James

The 6809 microprocessor looks like reviving interest in the S50 bus. We take a look at its various virtues.

The S100 bus standard has become so accepted by the microcomputer community that other bus standards have tended to be ignored. The S100, with so many manufacturers supporting so many different computers and plug-in cards, has tended to kill off any attempts at alternatives. Perhaps the one exception has been the similarly named S50 bus. In the same way that the S100 came from the control line requirements of the Intel 8080, the S50 came from the Motorola 6800. Most of the similarities and differences between the two buses can be seen in Table 1.



Micro History

In the early days of microcomputing the S50 bus was almost as popular as the S100. Indeed, in this country, there was a time when the S50 was by far the most used, mainly due to the pioneering efforts of Computer Workshop importing SWTP equipment. Later the S100 became the most popular bus, for various reasons many different manufacturers produced equipment based on the S100. The Z80 was the most powerful MPU and was only available on the S100 (a brief experiment using the Z80 on the S50 did not catch on). Microsoft produced a range of powerful software for the 8080/Z80, and eventually Digital Research produced CP/M, a rapidly accepted disc operating system.

My own route into microcomputers was via the S50/6800 system and, like many others, I eventually believed that the S100 was better and switched to an S100/Z80 based system. After some time using CP/M, interfacing various bits and pieces of equipment and trying hard to believe what everyone else was still telling me about S100/Z80 systems, I decided to give the S50 another try. My reasons for abandoning the over-complex, hardly standard S100, the arbitrary architecture of the Z80, and the primitive CP/M, will become clearer during the rest of this article.

S50 Revisited

The basic structure of the S50 bus can be seen in Table 2. Nearly all of the

	S100	S50
Produced By	ALTAIR	South West Tech. Products (SWTP)
1st CPU	8080	6800
2nd CPU	Z80	6809
Other CPUs	8085	6502/Z80 (not popular)
I/O	256 undecoded	8 fully decoded 4/16 registers each
Improvements	IEEE S100	S50C
Manufacturers	Many	Few large companies
Main DOS	CP/M	FLEX
Software	wide range	not much applications software

Table 1. Similarities and differences between S100 and S50 users.

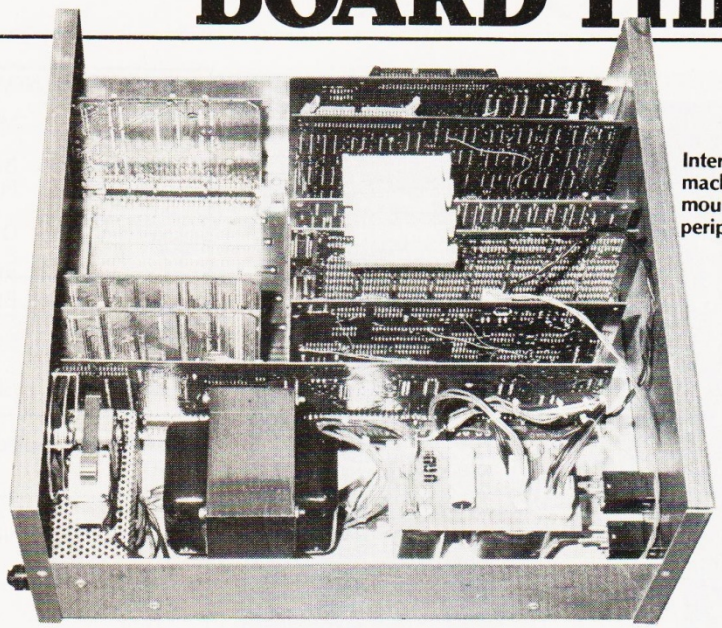
S50 NAME (pins 1 to 50)	DESCRIPTION
D0	
D1	
D2	
D3	eight bi-directional
D4	inverted
D5	data lines
D6	
D7	
A15	
to	16 address lines
A0	
GRD	
GRD	Ground
GRD	
+8V	
+8V	
+8V	
−16V	
+16V	
not used	Location (index) pin
MRST	Manual Reset
NMI	Non Maskable Interrupt
IRQ	Interrupt
UD2	User defined
UD1	User defined
Ø2	Phase two clock (1-2 MHz)
VMA	Valid address indication
R/W	Read/Write
Reset	
BA	Bus available
Ø1	Phase one clock
HALT	
110b	110 baud line
150b	150 baud line
300b	300 baud line
600b	600 baud line
1200b	1200 baud line

Table 2. The S50 bus structure.

bus lines are derived from the 6800 MPU's connections. 16 address lines provide the same amount of addressing as the S100. Eight bi-directional data lines contrast with the S100's 16 uni-directional data lines. Most of the other lines are fairly straightforward and self-explanatory. Anyone familiar with the S100 will be surprised at the relatively few control lines used. That they *are* enough is something that can only be proved by experience.

The greatest difference between the S50 and the S100 is, in fact, not part of the main bus definition at all. The S50 bus has an auxiliary I/O bus consisting of 30 pins (not strictly a bus at all because not all the pins are paralleled). This is sometimes referred to as the S30 bus and its specifications can be seen in Table 3. The most unusual feature of the S30 bus is the presence of pin 1, an I/O select pin. The S50 bus is so organised that every S30 bus slot occupies a certain number of address locations (usually four, but see the definition of the S50C later) and when an address in the slot's range is output on the main bus the I/O select pin goes low. This means that any I/O card plugged into an S30 slot need only examine pin 1 to discover if it is being addressed or not. Thus, I/O cards need very little circuitry for this purpose.

Although not part of the S50 standard, most S50 computers have eight S30 I/O ports, usually at the rear of the main chassis. As the S50 bus is organised around the 6800 MPU the S30 I/O bus is organised around the 6800's peripheral chips — the 6800 PIA, and the 6850 ACIA. Thus RS0 and RS1 are used as register select lines to determine which control/data register of a 6820 is being addressed. Having only two register selects means that each S30 slot can only access four I/O registers. Thus, more advanced peripheral chips, such as the MOSTEK 6522 VIA, cannot be used. (A problem overcome with the advent of the S50C extended but — see later). To recap, each S30 slot has one I/O select pin which goes low when the slot is addressed and occupies four distinct addresses in the main memory space, usually referred to as an I/O port.



Internals of an S50 based machine. The small cards are mounted on the S30 peripheral bus.

A Simple Interface

To show how easy it is to construct a custom interface on the S50 bus we will consider a simple example. Rather than choosing to interface a standard Motorola device such as a 6820 PIA, which, after all the S30 bus was designed to make easy, we will interface the ZN425E D to A converter chip.

The ZN425E chip is not designed to be used directly on a microprocessor bus and has only eight non-latched data inputs. So, the first thing we must do is to provide a latch. A 74100 octal latch solves this problem nicely and, as we are not too fussy about decoding all of the register locations, a 7402 NOR gate

S30 NAME (pins 1 to 30)	DESCRIPTION
UD3	user defined
UD4	user defined
−12V	
+12V	
GND	
GND	
not used	Location (index) pin
NMI	
IRQ	
RS0	Register select 0
RS1	Register select 1
D0	
D1	
D2	
D3	eight bit
D4	bi-directional
D5	data lines
D6	
D7	
Ø2	Phase two clock
R/W	
+8V	
+8V	
1200b	
600b	
300b	
150b	
110b	
RESET	
I/O SELECT	

Table 3. The S30 bus structure.

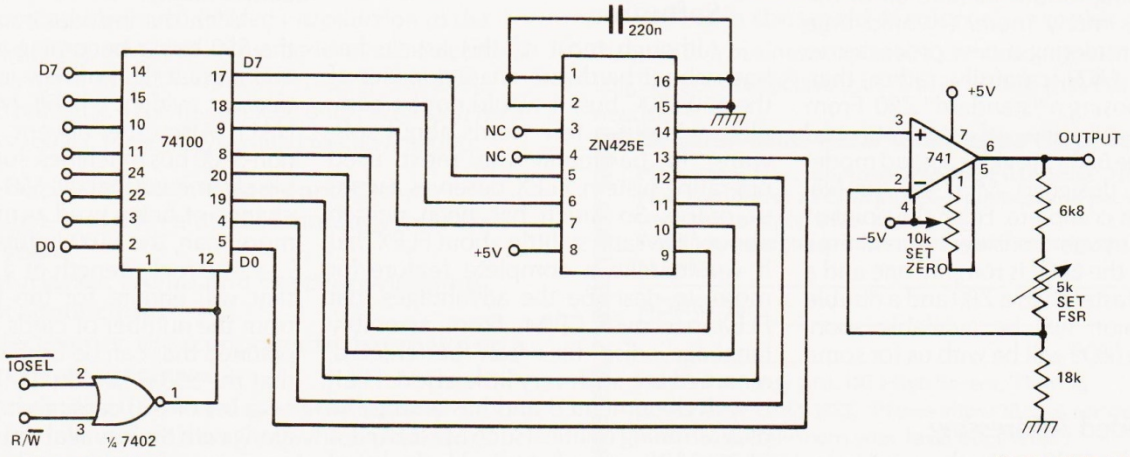
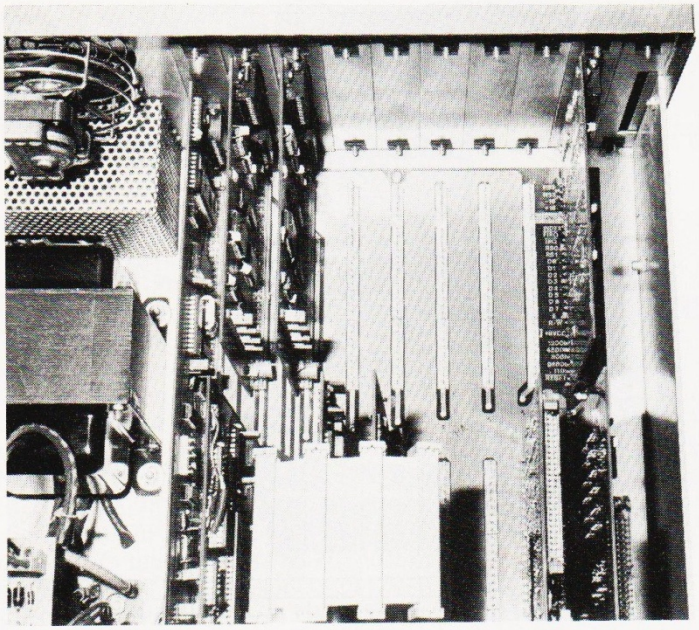


Fig.1 The simple analogue interface.



A close-up of the S30/S50 buses. Note the neat way the cards mount directly to the rear of the case allowing sockets to be easily fitted.

OLD S50 NAME	NEW S50C	COMMENTS
MRST	MRDY	Memory ready line (for slow memory)
NMI	BUSY	Bus in use
UD2	FIRQ	Fast interrupt request (New 6809 interrupt)
UD1	Q	Clock line
02	E	Clock line
01	BS	Bus status
110b	BUSRQ	Bus request
150b	S3	A19
300b	S2	A18
600b	S1	A17
1200b	S0	A16

Table 4. Changes on the S50C.

OLD S30 NAME	NEW S30C	COMMENTS
UD3	RS2	Register select line two
UD4	RS3	Register select line three
NMI	FIRQ	Fast interrupt request
600b	4800b	
150b	9600b	

Table 5. Changes on the S30C.

solves the problem of when to latch the data bus. The final circuit (including analogue components) can be seen in Fig. 1. It's as easy as that!

The Processors — 6800 And 6809

Another delight of the S50 bus is the 6800 microprocessor. The standard micro on the S50 may only have two accumulators (A and B registers), one index register (X), and a stack pointer, but its addressing modes are extensive and uniform. That is, every instruction (except for a few obvious exceptions) may use all of the addressing modes. All in all, the 6800 is a well designed processor that is easy to program in assembler code.

Recently Motorola has introduced the 6809 as a replacement for the 6800. With two accumulators, index registers and stack pointers, the 6809 is powerful. Its addressing modes include all of the 6800's plus many more. I would urge anyone considering a new processor to study the 6809 carefully rather than simply choosing a "standard" Z80. From the point of view of students and teachers the 6809 provides a good model of a well designed MPU — simple, elegant and complete. From the point of view of anyone considering real-time processing the 6809 is roughly one and a half times faster than a Z80 and a double speed version will be available soon. Clearly the 6809 will be with us for some time.

Extended Addressing

With the 6809 came the need to increase the addressing range of the S50 bus. Also some extra control lines used by the 6809 are not included in the S50 bus definition. These problems have been overcome by the S50C bus definition, the main features of which can be seen in Table 4, the corresponding new S30C bus definition is given in Table 5. The main improvements are the provision of four extra address lines, giving access to one megabyte of main memory, and two extra register select lines, giving each I/O port sixteen memory locations. These two details make the S50C bus ready for the next generation of micros. Comparing the S50C with the S50 definition indicates that S50/S30 devices will work on the S50C/S30C bus with little or no modification. Going the other way is not always so easy but some manufacturers make plug-in cards that can be used on both versions of the S50.

Software

Although most of this article has been about hardware characteristics of the S50/S50C bus, it would not be complete without a few words about software. In particular the most used operating system, FLEX, deserves a word of praise. So much has been written about CP/M and so little about FLEX that it would take a complete feature (or more) to describe the advantages that FLEX has over CP/M. From assembly language, disc files can be created, renamed etc. with very little effort. FLEX is well documented and has a range of programming utilities (such as DEBUG, a 6800/6809 simulator). High level languages are also available and share most of FLEX's features. It is enough (for the moment) to say that all the software making up the FLEX system is user, rather than programmer, oriented.

The Future

At this point I hope I have convinced you that the S50 bus has advantages for some purposes. I would not suggest that the S50 was always the best — it too has its problems. In particular for the next generation of micros an eight bit bidirectional data bus will be too small. Whether another eight pins (or more) can be found is a matter of some doubt but, even so, a 68000 card for the S50 is scheduled for early this year. It is certainly true that the deficencies will become more apparent as time moves on but the S50 will always be a simple-to-use, and cheap, alternative to whatever else comes along.

With the introduction of the 6809, the S50 bus is becoming popular again and a great deal of new activity and interest is evident (viz 68' MICRO JOURNAL). Also, the advent of so many non-S100 bus machines, such as PET, Apple etc, means that the S50 stands a good chance of being used as much as, if not more than, the S100 in future.

The real strength of a bus standard that will endure for the future comes from the number of cards available and planned that can be used on it. To show that the S50 is healthy I include Table 6 — a list of S50 cards that I know about along with their availability. This list is by no means complete and I apologise to

any manufacturers whose products I may have omitted.

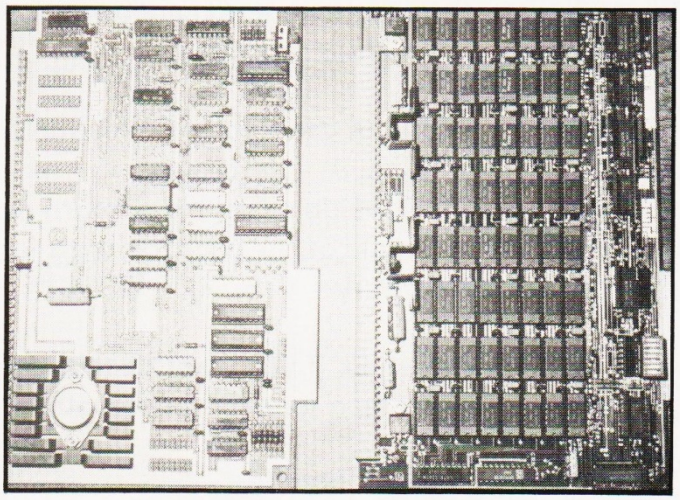
Conclusion

By this time it should be clear that I think the S50 bus plus the 6809 plus FLEX makes a good system. In particular:

*S50 cards are simple and cheap
*The S30 bus is easy to interface to a variety of devices
*A wide range of cards is in production
*A wide range of cards is planned for the future by a number of manufacturers
*The 6089 is an elegant and powerful processor
*FLEX is an elegant and powerful operating system
*Some excellent systems software is available (BASIC, Pascal, FORTRAN etc)

CARD	COMMENTS	AVAILABILITY
6800 CPU	At least three types	NOW
6809 CPU	Two current more planned	NOW
68000 CPU	Not much information yet	1st Q 1981
Memory	All types from 4K to 32K with many different features	NOW
SERIAL	One, two or eight channel RS232	NOW
PARALLEL	One or eight (20 bit) channels	NOW
TIMERS	Interrupt and interval	NOW
EPROM PRG	Both 2716 & 2708	NOW
EPROM CARDS	Both 2716 & 2708	NOW
A to D's	Fast 12 and 8 bit types	NOW
D to A's	Fast 12 and 8 bit types	NOW
VDU CARD	With low res graphics	NOW
HIGH RES	High resolution graphics card	3rd Q 1980
DISC CONTROL	With drives for both 8" and 5"	NOW
DISC CONTROL	Without drives for 8" and 5"	3rd Q 1980
PROTOTYPE	S30 and S50	NOW
EXTENDER	S30 and S50	NOW

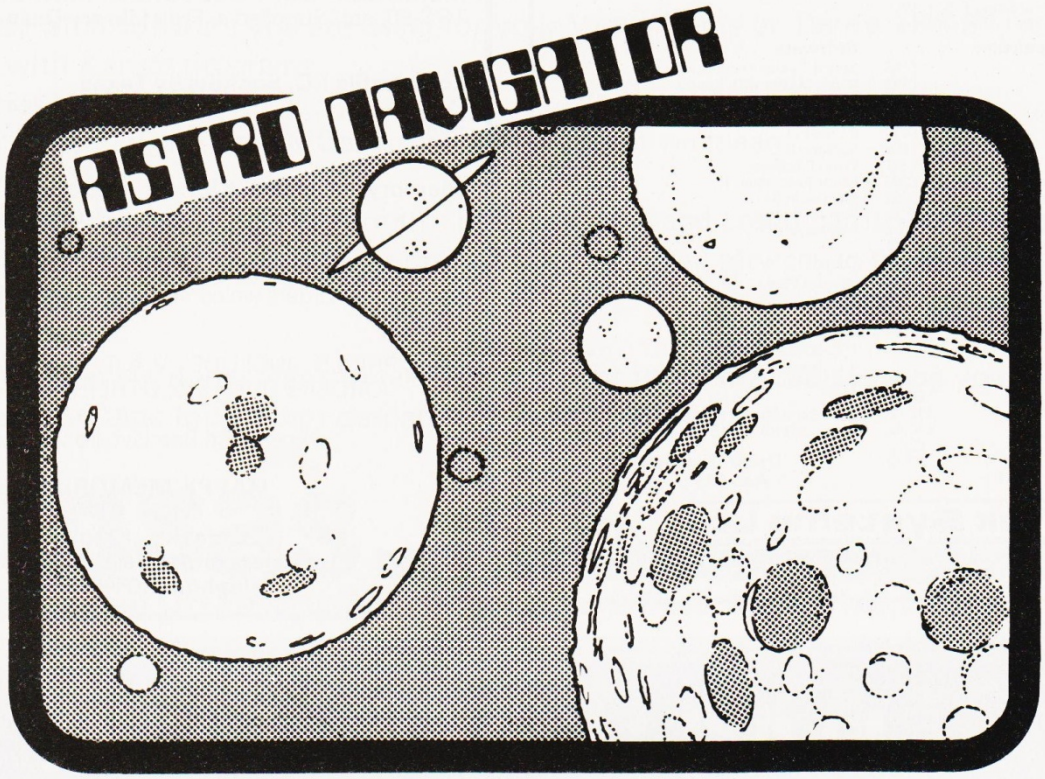
Table 6. What's available for the S50.



A pair of typical S50 based cards showing their compactness.

Our thanks are due to Computer Workshop of 38 Dover Street, London for providing photographic facilities.

INNOVATIVE
TRS-80 SOFTWARE
FROM THE PROFESSIONALS



Coming as it does shortly after the recent successful Voyager probe to Saturn, this program is particularly well timed. It programs the TRS-80 or Video Genie to produce a complete and highly accurate simulation of the solar system. All of the orbits of the various planets are correctly calculated, as are their orbital speeds and gravitational pulls. Each time the game is played, the members of the solar system are differently placed, but still in correct relationship to each other and to the Sun. Hence every game is different and presents different problems to the player. There are only one or two small deviations from actual fact. One is that each planet has a mythical shuttle orbiting it from which, if you can get into orbit with the planet, you can draw fuel and so continue your journey. The purpose of the game is to blast off from the planet of your choice and travel throughout the solar system. There is no other purpose. There are no prizes, no free goes, nothing else. If you succeed in making a landing on another planet then your reward is the thrill of having been able to do so. And for some inexplicable reason, it really is a thrill. Probably this is because the game is unbelievably difficult as all of the physical laws and relationships are obeyed. Although the player of this game has the help of a computer, it will only tell him the statistics of the journey. It is for the player to decide how much fuel to take on, what thrust to use, whether to try and blast off slowly so that fuel can be taken on at the orbital station (this, incidentally, is mandatory where the gravity is very high, such as Jupiter, as it is not possible to take off with enough fuel to attain escape speed) or whether to try and get away from the home planet as quickly as possible. The astronaut has three maps to which he may refer. The first is of the outer planets, the second of the inner planets and the third a close up view, if he is in the proximity of any planet. Superimposed on these maps is the present position of the spaceship together with the last few positions which have been occupied. It takes a large degree of experience to play the game in order to make any headway with it at all. One has to get used to a whole new mode of travel where the attitude of the craft may bear no relation whatever to the direction in which it is travelling. At all times gravitational pull, the laws of momentum and many other considerations are acting on the craft's course. Furthermore, journeys are judged in lengths of months and years. For instance, if you take off from Earth and have a look at the map to see where Jupiter is, then point your craft in that direction, and blast, there is not much chance that you will get anywhere near Jupiter because by the time you get there it will be long gone! Just as the Voyager used Saturn to pull itself, like a sling shot, onto a different path, so the player of Astro Navigator can use the gravitational pull of planets to change course without having to use valuable fuel. Most of the time, of course, the craft is not under the control of its motors at all, but is coasting through space, affected, as we have said, by many different laws of the universe as it goes. Frankly, we are not sure why the game is so appealing, graphics are used but are really only subsidiary to the play. Probably it is simply the fact that one is entirely on one's own out there and will fail or succeed entirely by reason of one's own skills. For what it is worth, it is one of the very few programs in which we got so engrossed when testing it, that the session has gone on ever since! Astro Navigator is written in Level II Basic but is also compatible with Disk Basic.

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27) What sex are you? Male/Female

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PERSONAL COMPUTER WORLD					
ELEKTOR					
ELECTRONICS TODAY					
COMPUTING TODAY					50
PRINTOUT					

39) Do you read any of the video magazines? Yes/No
If Yes please specify

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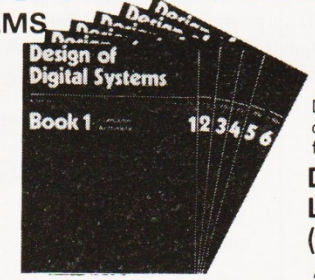

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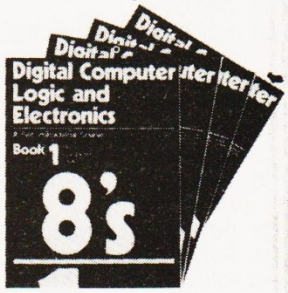

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SNAKES

T G Royle

Wriggle out of this one

This program was written on a Tangerine MICRON and plays a slightly unusual graphics game. The object is to steer your 'snake', represented by ***>, around the screen. At random time intervals and in random locations, blocks will appear and the object is to get the head of your snake into the block. If you do this before the block dissapears then you are awarded a score. This score is added to your total and is then 'counted-down'. When it reaches zero you can roam off in search of another block. As time progresses your snake gets longer and the risk of crossing your previous path increases. If this happens, or if you hit the outer wall, you will lose one of your three lives.

Game Alterations

Changes can be made by adjusting the value of R in lines 82-86, a smaller value will make the snake move faster. Reducing the value of W in line 253 increases the speed at which the snake gets longer.

The random number seed in line 800 controls the time between each block being generated. The seed in line 710 controls the time for which each block is displayed.

Some of the other lines are of note for non-MICRON owners. Line 2 performs a 'Clear Screen' function and line 26 deletes the character on the screen after a GET, this is needed owing to a fault in the original Microsoft BASIC. The PEEK in line 255 returns the Hex value of the last key pressed.

Notes

The MICRON screen is based on a 32 character line with 16 lines on the screen at any one time. Memory locations between 512 and 1023 are used for PEEKing and POKEing to the display. In general, the character set for graphics is the same as that used by the NASCOM, see our last 'Graphic Details' article.

Program Listing

```
 2  FOR I=1 TO 16:PRINT : NEXT I
 4  A=544 : B=575 : C=1023 : D=992 : E=0
 6  FOR I=A TO B : POKE I,42: NEXT I
 8  FOR I=B TO C STEP 32:POKE I,42:NEXT I
10  FOR I=C TO D STEP-1:POKE I,42:NEXT I
12  FOR I=D TO A+32 STEP-32:POKE I,42:NEXT I
14  A=A+32:B=B+31:C=C-33:D=D-31:E=E+1
16  IF E=6 GOTO 20
18  GOTO 6
20  POKE 781,83:POKE 782,78:POKE 783,65:POKE 784,75:
    POKE 785,69:POKE 786,83
24  PRINT "DO YOU WANT INSTRUCTIONS": PRINT PRESS 'Y'
    FOR YES, 'N' FOR NO."
26  GET A$:POKE 3,0:IF A$="N" THEN FOR I=1 TO 8: PRINT:
    NEXT I:GOTO 70
30  PRINT: PRINT: PRINT: PRINT: "A SNAKE OF '<**' WILL
    MOVE"
32  PRINT "AROUND THE SCREEN UNDER YOUR"
34  PRINT "CONTROL, YOU CAN CHANGE IT'S"
36  PRINT "DIRECTION BY PRESSING:-"
38  PRINT " [2 SPC] 2 TO MAKE IT MOVE DOWN"
40  PRINT " [2 SPC] 8 TO MAKE IT MOVE UP"
42  PRINT " [2 SPC] 4 TO MAKE IT MOVE LEFT"
44  PRINT " [2 SPC] 6 TO MAKE IT MOVE RIGHT"
45  PRINT "PRESS 'SPACE' TO CONTINUE":GET A$
46  FOR I=1 TO 4:PRINT:NEXT I:PRINT "YOU HAVE 3 LIVES
    (NUMBER TOP RIGHT)"
48  PRINT "YOU WILL LOSE ONE IF YOU:-"
50  PRINT " [2 SPC] 1)HIT AN OUTER WALL"
52  PRINT " [2 SPC] 2)DOUBLE BACK ON YOURSELF"
54  PRINT " [2 SPC] 3)CROSS OVER YOURSELF":FOR I=1 TO
    6:PRINT:NEXT I
55  PRINT "PRESS 'SPACE' TO CONTINUE":GET A$
56  PRINT:PRINT:PRINT:PRINT "THE OBJECT IS TO HIT INTO
    THE"
58  PRINT "BLOCKS WHICH APPEAR RANDOMLY BUT";
60  PRINT "ONLY STAY FOR A SHORT TIME SO BE";
62  PRINT "QUICK".
64  PRINT "THE SNAKE GETS LONGER AS THE [3 SPC] GAME
    GOES ON."
70  PRINT:PRINT:PRINT:PRINT "ENTER YOUR RATING:-"
72  PRINT " [2 SPC] BEGINNER [4 SPC]=B"
74  PRINT " [2 SPC] NOVICE [6 SPC]=N"
76  PRINT " [2 SPC] EXPERT [6 SPC]=E"
78  GET A$:POKE 3,0
82  IF A$="B" THEN R=120:GOTO 100
84  IF A$="N" THEN R=100:GOTO 100
86  IF A$="E" THEN R=60:GOTO 100
88  GOTO 70
100 FOR I=1 TO 16:PRINT:NEXT I
120 J=PEEK(49136):FOR I=545 TO 574:POKE I,192:POKE
    I+448,3:NEXT I
130 FOR I=576 TO 960 STEP 32:POKE I,170:POKE I+31,85: NEXT
    I:POKE 49139,0.
135 DIM P(100)
140 X=1:Y=32:L=3:LL=3:T=0:T1=1+INT(9*RND(1)):SC=0:
    POKE 538,48+L
145 S2=48:S3=48:S4=48:S5=48:POKE 516,S5:POKE 517,S4:
    POKE 518,S3:POKE 519,S2
150 P=INT((698-677)*RND(1)+677):B=INT(5*RND(1)):P=P+
    (B*32)
160 A=2*INT((28-25)*RND(1)+25):GOTO 260
250 T1=T1-1:IF T1=T THEN 700
252 T2=T2-1:IF T2=T THEN 800
253 W=W+1:IF W=50 THEN 1600
255 A=PEEK(1)
260 IF A=50 THEN M=Y:DI=86:GOTO 410
270 IF A=52 THEN M=-X:DI=60:GOTO 410
280 IF A=54 THEN M=X:DI=62:GOTO 410
290 IF A=56 THEN M=-Y:DI=94
410 P=P+M: IF PEEK (P)<>32 THEN 600
420 POKE P,DI:FOR I=1 TO R:NEXT I
430 FOR LA=LL TO 1 STEP-1:P(LA)=P(LA-1):NEXT LA:P(1)
    =P:POKE P(LL),32:POKE P(1),42
440 GOTO 250
600 IF PEEK (P)=255 THEN 900
610 L=L-1:POKE 538,48+L
620 IF L=0 THEN 1000
625 FOR LB=1 TO LL:POKE P(LB),32:NEXT LB:POKE E,32
630 FOR I=1 TO 2000:NEXT I:GOTO 150
700 E=INT((607-577)*RND(1)+577):F=INT(13*RND(1)):E=E+
    (F*32)
705 IF PEEK (E)<>32 THEN 700
```

```
710  J=PEEK (49136):POKE E,255:POKE 49139,0:T2=INT((60-10)*
     RND(1)+10):GOTO 255
800  POKE E,32:T1=1+INT(9*RND (1)):GOTO 255
900  S1=INT((58-49)*RND (1)+49)
910  POKE P,S1:SC=SC+1:FOR I = 1 TO 200:NEXT I
920  S2=S2+1:IF S2>57 THEN S3=S3+1:S2=48
930  IF S3>57 THEN S4=S4+1:S3=48
940  IF S4>57 THEN S5=S5+1:S4=48
950  IF S5>57 THEN 1200
960  POKE 516,S5:POKE 517,S4:POKE 518,S3:POKE 519,S2
970  S1=S1-1:IF S1>47 GOTO 910
980  GOTO 800
1000 FOR I=1 TO 8:PRINT:NEXT I:PRINT " [12SPC] GAME OVER"
1010 PRINT " [8 SPC] YOUR SCORE IS";SC:FOR I=1 TO
     6:PRINT:NEXT I:GOTO 1500
1200 FOR I=1 TO 8:PRINT:NEXT I:PRINT " [13SPC] YOU WIN"
1210 PRINT " [4 SPC] YOUR SCORE IS OVER 9999" :FOR I=1 TO
     6:PRINT:NEXT I
1500 PRINT "DO YOU WISH TO PLAY AGAIN"
1510 PRINT "PRESS 'Y' FOR YES, 'N' FOR NO"
1520 GET A$:POKE 3,0
1530 IF A$="Y" THEN 100
1540 PRINT " [3 SPC] THANK YOU.":END
1600 LL=LL+1:W=0:R=R-Z
1610 IF R<=10 THEN R=10
1620 GOTO 225
```

ZX80 NIM

J McCartney

Beats 'Matchsticks' any day of the week

Whilst this game makes no claims for its originality it does illustrate just how much you can expect to cram into the ZX80's 1K of RAM. This version of NIM displays three rows of markers, each of which contains a random number of elements from two to seven. You can take any number of elements from any row in your turn but whoever removes the last element loses.

Fitting It In

The program just fits into the 1K of RAM, the listing does show through in some cases but at least it doesn't crash. If you are in proud possession of the extension memory units or the new 16K module then you can probably improve the commenting and instructions.

To play the program once loaded, simply key RUN and NEWLINE. The program will prompt for the number of elements you wish to remove (line 130) and from which row (line 160), each of these should be followed by NEWLINE. The game is programmed never to produce identical rows (in line 90) and will also check to ensure that it never gives you a winning combination to start with, the subroutine at 400 checks for this.

All entries are validated, an attempt at cheating will lose you the game. Because you have the first move you should be able to win every time. Five consecutive wins gives you the match.

Strategies

The game routine is contained in the subroutine at 400 so if you like you can work it out. It is worth remembering the the ZX80 only works with integers.

The scoreboard is produced by lines 430 to 490 and the screen display is produced in the routine from line 500. The graphics character is in the standard code, ie it's the graphic on the 'Q' key.

Program Listing

```
10   CLEAR
20   LET B=0
30   LET C=0
40   PRINT "NEW MATCH"
50   DIM A(2)
60   FOR J=0 TO 2
70   LET A (J)=RND(6)+1
80   NEXT J
90   IF A(0)=A(1) OR A(1)=A(2) OR A(0)=A(2) THEN GOTO 60
100  GOSUB 400
110  IF J=4 THEN GOTO 60
120  GOSUB 500
130  PRINT "YOUR TURN. HOW MANY?"
140  INPUT Y
150  PRINT
160  PRINT "WHICH SET?"
170  INPUT X
180  CLS
190  IF X<1 OR X>3 OR Y<1 THEN GOTO 430
200  LET A(X-1)=A(X-1)-Y
210  IF A(X-1)<0 THEN GOTO 430
220  IF A(0)+A(1)+A(2)=0 THEN GOTO 440
230  GOSUB 500
240  PRINT "MY TURN. KEY 0,NEWLINE."
250  INPUT Q
260  CLS
270  FOR H=1 TO 7
280  FOR J=0 TO 2
290  LET A(J)=A(J)-H
300  IF A(J)<0 THEN GOTO 350
310  IF Q=1 THEN GOTO 120
320  GOSUB 400
330  IF J=4 THEN GOTO 120
340  IF M=0 THEN GOTO 460
350  LET A(J)=A(J)+H
360  NEXT J
370  NEXT H
380  LET Q=1
390  GOTO 270
400  LET M=A(0)+A(1)+A(2)+(A(0)/2+A(1)/2+A(2)/2)*8
     +(A(0)/4+A(1)/4+A(2)/4)*80
410  IF M=222 OR M=220 OR M=202 OR M=200 OR M=22 OR
     M=20 OR M=3 OR M=1 THEN LET J=4
420  RETURN
430  PRINT "CHEAT"
440  LET B=B+1
450  GOTO 470
460  LET C=C+1
470  PRINT "SCORE: ZX80 ";B;" PLAYER ";C
480  IF B=5 OR C=5 THEN GOTO 10
490  GOTO 50
500  PRINT
510  FOR J=0 TO 2
520  PRINT J+1
530  IF A(J)=0 THEN GOTO 570
540  FOR H=1 TO A(J)
550  PRINT " Q";
560  NEXT H
570  PRINT
580  PRINT
590  NEXT J
600  RETURN
```

KITCHEN CALCULATOR

Tim Goldingham

Gourmet's Guide in BASIC

If 'Ever since you got that computer, I hardly see you!' is your wife's complaint, perhaps this little ZX80 program will help to reassure her that you still have her interests at heart.

The program calculates the time needed to cook a joint of beef, lamb, veal or pork of a given weight. Acknowledgement is due to the Good Housekeeping Cookery Book for the timings used; and to Clive Davies of Cheltenham for the subroutine at line 600 which converts the string at line 20 into an array.

The author accepts no responsibility for any culinary catastrophe resulting from the use of this program!

Program Listing

```
10    DIM Z (16)
20    LET Z$ = "20252733202527352530999925999932"
30    FOR X = 1 TO 16
40    GOSUB 600
50    LET Z(X) = N
60    NEXT X
70    PRINT "BEEF(1)/LAMB(2)/VEAL(3)/PORK(4)? ";
80    INPUT A
90    PRINT A
100   PRINT "ROLLED(1)/ON BONE(2)? ";
110   INPUT B
120   PRINT B
130   PRINT "425(1)/350F(2)? ";
140   INPUT C
150   PRINT C
160   LET A = A(A*4) – 3
170   LET B = B – 1
180   IF C = 1 THEN LET C = 0
190   LET D = Z(A + B + C)
200   IF D < 99 THEN GOTO 230
210   PRINT "NOT RECOMMENDED"
220   STOP
230   PRINT "LBS: ";
240   INPUT E
250   PRINT E
260   PRINT "OZ : ";
270   INPUT F
280   PRINT F
290   PRINT "SERVING TIME? HRS:";
300   INPUT G
310   PRINT G
320   PRINT ,"MINS   :";
330   INPUT H
340   PRINT H
350   IF G < 12 THEN LET G = G + 12
360   LET H = (G*60) + H
370   LET H = H – D
380   LET H = H – D
390   LET E = E – 1
400   IF E>0 THEN GOTO 380
410   LET J = (F*10)/16
420   LET J = (J*D)/10
430   LET H = H – J
440   LET K = 0
450   LET H = H – 60
460   LET K = K + 1
470   IF H > 59 THEN GOTO 450
480   PRINT
490   PRINT "START COOKING AT ";K;".";H;
500   IF D = 32 THEN PRINT " AT 375F"
510   STOP
600   LET N = 0
610   FOR I = 1 TO 2
620   LET N = (N*10 + CODE(Z$) – 28)
630   LET Z$ = TL$(Z$)
640   NEXT I
650   RETURN
```

PERSONAL BANKER

E Pue

An ingenious, self modifying program to account for your spending

Maintaining a record of your bank balance is an obvious application for your microcomputer. However, storage of the balance on a data tape complicates the operation. This program for PET users provides a simple means of updating not only your current account balance but also other deposit/savings accounts *without* the necessity for a data tape. Data is stored within the program which is updated and saved after entering credits/debits. There should be no problem in adapting the program to other systems providing you can identify the address at which the first character of the DATA is stored in your machine.

Self Modification

The DATA statement *must* be in the first line of the program, not necessarily at line 0, but this resists the temptation to preface it with REM statements, etc. The subroutine at line 500 updates characters in the DATA statement before SAVEing. Provision is made for three separate balances, but this can be extended if desired. To do this simply ensure that there is sufficient padding in the DATA statement, but be careful that the number of characters does not exceed 72 (date plus balances, including commas and potential negative signs). The DATA line may look a little odd at times but this is unimportant as superfluous characters are not read.

Debits should be entered as negative values. If you make an error, or are reluctant to accept the updated balance, line 330 provides an opportunity to re-enter. This facility requires the temporary "X" variables and the line 110 RESTORE. Cash amounts are "pence" justified in lines 240-270.

Lines 460-480 may be omitted if you have sufficient confidence in your cassette. Although based on a PET, no file handling takes place — all this is done by the system software, so any other Microsoft BASIC should run the program.

Program Listing

```
0    DATA 00,00,00,0.00,0.00,0.00,000000000000
100  J=1:T$(1)="CURRENT":T$(2)="DEPOSIT":T$(3)
     =SAVINGS"
110  RESTORE
120  READ D,M,Y,B$(1),B$(2),B(3)
130  PRINT " [CLS ];T$(J);" A/C BALANCE AT ";D;M;Y
140  PRINT TAB(54); " [REV ]";B$(J);" "
150  IF J>1 THEN 170
160  PRINT:INPUT "DATE (D,M,Y)": X1,X2,X3
170  PRINT:PRINT "ENTER CREDITS/DEBITS ('0' TO
     TERMINATE) ":PRINT
180  B=VAL(B$(J))
190  FOR I=1 TO 100
200  INPUT C
210  IF C=0 THEN 230
220  B=B+C:NEXT
230  REM**JUSTIFY BALANCE TO 2 DECIMAL PLACES
240  B=INT(B*100+.5)/100:X$(J)=STR$(B)
250  IF B=INT(B) THEN X$(J)=X$(J)+".0"
260  L=LEN(X$(J))
270  IF MID$(X$(J),L-1,1)="." THEN X$(J)=X$(J)+"0"
280  PRINT:PRINT T$(J);" A/C BALANCE AT ";X1;X2;X3
290  PRINT TAB(54);" [REV ]":X$(J):" "
300  PRINT:PRINT "KEY 'S' TO SAVE OR 'R' TO REPEAT
     ENTRY"
310  GET Q$:IF Q$="" THEN 310
320  IF Q$="S" THEN 350
330  IF Q$="R" THEN 110
340  GOTO 300
350  IF J=3 THEN 370
360  J=J+1:GOTO 130
370  A=1029:N$=STR$(X1):GOSUB 500
380  N$=STR$(X2):GOSUB 500
390  N$=STR$(X3):GOSUB 500
400  FOR J=1 TO 3
410  N$=X$(J):GOSUB 500
420  NEXT
430  PRINT:INPUT "TAPE #1 REWOUND READY TO SAVE?";Q$
440  IF LEFT$(Q$,1)< >"Y" THEN 430
450  SAVE "A/C BALANCES"
460  PRINT:INPUT ""TAPE #1 REWOUND READY TO
     VERIFY?";Q$
470  IF LEFT$(Q$,1)< >"Y" THEN 460
480  VERIFY "A/C BALANCES"
490  END
500  REM**UPDATE DATA STATEMENT
510  FOR K=1 TO LEN(N$)
520  M$=MID$(N$,K,1)
530  IF M$=" " THEN 550
540  A=A+1:POKE A,ASC(M$)
550  NEXT
560  A=A+1:POKE A,44:RETURN
```

BASE CHANGER

W S Lounds

From binary to hexadecimal and back with a helping hand from ASCII

The following simple program will assist those of you who have trouble with converting between bases. It also demonstrates a different method of extracting numerical information from alphanumeric data, letting the ASCII code do the work for you!

If your version of BASIC can handle strings then you will have no trouble in implementing this, if you have only a minimal BASIC then it should still be possible to recover the ASCII value from a character but you will need to build an array rather than a string.

Program Listing

```
10   REM**BASE CHANGER
20   PRINT "THIS PROGRAM WILL CHANGE FROM ANY
     BASE"
30   PRINT "< = 16 TO ANY OTHER BASE < = 16."
40   INPUT "WHAT IS THE OLD BASE";X$
50   E=0
60   IF X$="" THEN 30
70   GOSUB 390
80   B=N
90   IF N<2 OR N>16 THEN 30
100  INPUT "WHAT IS THE NUMBER";X$
110  IF X$="" THEN 100
120  GOSUB 430
130  IF E=1 THEN PRINT "ERROR":E=0:GOTO 100
140  N1=N
150  PRINT X$;"IN BASE 10 IS";N1
160  IF N1<1000000 THEN 190
170  PRINT "THE NUMBER IN BASE 10 IS > = 1000000, THIS"
180  PRINT "MEANS THAT ERRORS MAY OCCUR"
190  INPUT "WHAT IS THE NEW BASE";X$
200  IF X$="" THEN 190
210  GOSUB 390
220  B1=N:IF N<2 OR N>16 THEN 190
230  B$=""
240  V=INT(N1/B1)
250  R=N1-V*B1
260  IF R>9 THEN 300
270  B$=B$+CHR$(R+48)
280  N1=V:IF V=0 THEN 310
290  GOTO 240
300  R=R+55:B$=B$+CHR$(R):N1=V:IF V< >0 THEN 240
310  PRINT "THE NUMBER IN BASE";B1;"IS";
320  FOR J=LEN(B$) TO 1 STEP-1
330  PRINT MID$(B$,J,1);:NEXT
340  PRINT
350  INPUT "ANY MORE NUMBERS (YES OR NO)";X$
360  IF X$="YES" THEN 30
370  IF X$="NO" THEN STOP
380  GOTO 350
390  N=0
400  FOR J=1 TO LEN(X$):D=ASC(MID$(X$,J,1))
410  N=N*10+D-48:NEXT
420  RETURN
430  N=0
440  FOR J=1 TO LEN(X$):D=ASC(MID$(X$,J,1))
450  IF D>47 AND D<58 THEN D=D-48:GOTO 480
460  IF D>64 AND D<71 THEN D=D-55:GOTO 480
470  E=1:RETURN
480  IF D> =B THEN E=1:RETURN
490  N=N*B+D
500  NEXT
510  RETURN
```

GRAPH SCALER

S Draper

Keeping track of your plotting

Whilst writing a multi-purpose waveform display program for the school's PET, I came up against the problem of drawing a graph of virtually any function which can assume practically any value.

The design criteria of the resulting auto-scaling program were as follows:

1) The routine must make efficient use of the available display space.

2) The axes must be labelled in reasonable steps (eg 0.1,0.2,0.3,etc).

The listing given below was the net result. It may be found useful as a sub-routine to an existing scientific program.

```
1000  REM**SUB-ROUTINE TO CALCULATE
      SCALES
1010  QU=YPEAK/DISP:LG=LOG(QU)/
      LOG(10)
1020  INTER=10↑(INT(ABS(LG))*SGN(LG)
      +SGN(LG)-1/2)
1030  REM**INTERMEDIATE VARIABLES
      CALCULATED
1040  YDIV=INT(QU/INTER)*INTER
1050  RETURN
```

As listed above YPEAK is the peak positive value of the function, in the range to be considered; DISP is the maximum number of Y divisions to be used positive of the X-axis; and YDIV is the Y step per division.

Note that it is assumed that, as in most electrical waveforms, the negative value of the function does not exceed the positive value.

BIT MANIPULATION

S Draper

I/O control in BASIC

Bit manipulation is a function normally associated with machine code programs. It is, however, a very important operation in most control applications (ie, in the control of peripherals). It is not, however, necessary to write the control portion of your program in machine code as may be thought at first.

The following routine will allow the setting of any bit or group of bits to a "1" or a "0" without affecting other bits in the same byte.

```
100  FOR A=1 TO 8
110  B=BYTE-INT(BYTE/2↑A)*2↑A
120  IF B>2↑(A-1)-1 THEN BT=1
130  IF D(A)=2 OR D(A)=BT THEN 150
140  BYTE=BYTE+2↑(A-1)*SGN(D(A)
     *2-1)
150  BT=0
160  NEXT
```

In this routine BYTE is the byte being operated on (this would later be POKEd into the location we wished to control). D(1) through D(8) are the values which we wish bits 1 through 8 respectively to assume. If we wish the value of a bit to remain unchanged D(A) should have the value of 2 for that bit. Note that when A equals 1 we are referring to the units bit, when it equals 2 the two's bit, and so on.

HEXDUMP

Martyn Croft

Screenfuls of Hex on a UK101

Here is a simple program for anyone contemplating machine programming on the UK101. Development of a complex machine code program is undoubtably made easier by using the extended monitor supplied with the computer. However, small machine code programs can be written out and entered under the monitor available in ROM. Unfortunately, to inspect the program one has to step through the memory locations one by one, checking the contents of each location. This is both tedious and fraught with disaster.

The program below allows you to simply enter the starting address of your program (or any other section of memory for that matter) and view on the screen the next 104 memory locations. Using two nested FOR. . . NEXT loops, the program PEEKs the required location, converts the decimal value to Hex using subroutine 1000, and prints a table of the memory contents. The address is also converted to Hex and displayed at the start of every line, that is, preceding every set of eight memory locations. The UK101 screen comfortably allows 13 such lines hence the 104 locations.

Thus, with a screen full of Hex digits it becomes a relatively simple matter to check a machine code program, if not all at once, then in fairly large portions.

Program Listing

```
 80  INPUT"STARTING ADDRESS";S
 90  IF (S-INT(S)<>0) OR (S<0 OR S>65535) THEN 80
100  PRINT
110  FOR L=S TO S+96 STEP 8
120  N=L:HI=3
125  PRINT TAB(3);
130  GOSUB 1010
140  PRINT" ";
150  FOR A=L TO L+7
155  IF A>65535 THEN PRINT:GOTO 210
160  N=PEEK(A):HI=1
170  GOSUB 1010
180  NEXT A
190  PRINT
200  NEXT L
210  PRINT
220  GOTO 80
230  END
1000  REM** DEC TO HEX CONVERSION
1010  FOR I=HI TO 0 STEP -1
1020  H=INT(N/16↑I)
1030  N=((N/16↑I)-H)*16↑I
1040  IF H<=9 THEN D=H+48
1050  IF H>9 THEN D=H+55
1060  PRINT CHR$(D);
1070  NEXT I
1080  PRINT" ";
1090  RETURN
```

TAPE LIBRARIAN

J Dartnell

An intelligent program filer for NASCOM

This program enables libraries of tapes and contents to be controlled. Therefore, your NASCOM can keep track of your tapes and programs without having to keep written records. The library may also be used for many other applications, eg. cassette or record libraries.

Each library is denoted by a character, eg. A,B,C etc. Thirty tapes (numbered 01H — 1EH) are catered for in each library. The physical contents of the library should be labelled A01 — A1E, for example. Each description can have a maximum of 20 characters.

When setting up a library for the first time load the program and use the monitor modify command to change location 0EC9H to the library identifier, eg 41H for library A. Then a cassette in the library can be used to store the program on one side and the data on the other. NB Always rewind the data cassette before dumping the tape library data.

The program is executed from 0ECBH and replies with "C?>". The following commands may then be entered:-

Command	Meaning
P N/L	Place an entry on the next available tape. This command returns with the monitor prompt ">" and the 20 character description should be entered followed by 'newline'.
FXX N/L	Delete the description on tape XX, eg. F1E N/L.
T N/L	Tabulates the contents of the library 15 lines at a time. Depressing the space bar displays the next 15 entries. One more depression returns to the command display. Tapes which are free to enter a description on are indicated by backward question mark.
/ N/L	Slash (/) indicates session finished. If the contents of the library have been changed during the session the program displays "D". In this case set the cassette up and start recording. Type "YES" when you are ready. The program will then dump the tape library, display "END" and return control to the monitor.
L N/L	Load a previously created copy of the library from tape.

When using the "P" command if there are no empty locations for a description then the message "NO TAPE" is displayed. If this happens either use the "F" command to delete any redundant entries, or start another library! The "NO TAPE" message may also be displayed if the tape does not exist in the library, enter the correct tape number in this case.

The program was developed using the T2 monitor, but is being used on a T4 monitor system, amendments are included for running under T4.

Program Listing

```
0EC9                    41 H          ;Library Tape
                                      Identifier "A".
0ECA                    XX            ;dump required
                                      indicator
0ECB 31 33 0C     START:LD SP,0C33H   ;set stack
                                      pointer
0ECE 06 1E              LD B,1EH      ;set B = 30
0EDO 3E 01              LD A,01H      ;set A = 01
OED2 21 50 0C           LD HL,0C50H   ;start address
0ED5 77            LAB1:LD(HL),A      ;dump tape
                                      number
0ED6 23                 INC HL        ;move pointer
0ED7 36 1A              LD(HL),1AH    ;dump not in
                                      use indicator
0ED9 23                 INC HL        ;move pointer
0EDA C5                 PUSH BC       ;save counter
0EDB 06 13              LD B,13H      ;set B = 19
0EDD 36 20         LAB2:LD(HL),20H    ;dump space
0EDF 23                 INC HL        ;move pointer
0EE0 10 FB              DJNZ,LAB2     ;repeat 19
                                      times
0EE2 C1                 POP BC        ;restore
                                      counter
0EE3 3C                 INC A         ;increment
                                      tape number
0EE4 10 EF              DJNZ,LAB1     ;repeat
0EE6 21 CA 0E           LD HL,OECAH   ;dump required
                                      indicator
0EE9 36 00              LD(HL),00H    ;clear indicator
0EEB CD E1 0F      COMM:CALL CCOM     ;get command
0EEE 11 4E 0B           LD DE,0B4EH   ;command
                                      character
                                      position
0EF1 1A                 LD A,(DE)     ;dump
                                      command to A
0EF2 00                 NOP           ;padding
0EF3 00                 NOP           ;padding
0EF4 FE 4C              CP A,4CH      ;compare with
                                      "L"
0EF6 CC EB 0F           CALLZ,TLOAD   ;if "L" call
                                      TLOAD
0EF9 FE 50              CP A,50H      ;compare with
                                      "P"
0EFB CC 48 0F           CALLZ,PLACE   ;if "P" call
                                      PLACE
0EFE FE 46              CP A,46H      ;compare with
                                      "F"
0F00 CC 75 0F           CALLZ,FREE    ;if "F" call
                                      FREE
0F03 FE 54              CP A,54H      ;compare with
                                      "T"
0F05 CC 18 OF           CALLZ,TTAPE   ;if "T" call
                                      TTAPE
0F08 FE 2F              CP A, 2FH     ;compare with
                                      "/"
0F0A 20 DF              JRNZ,COMM     ;try again
0F0C CD B5 0F           CALL TDUMP    ;dump table if
                                      required
0F0F EF 1F 45 4E 44 00 FINISH:RST 28H ;scroll "END"
0F15 C3 00 00           JP 00 00 H    ;return to
                                      monitor
0F18 EF 1E 00      TTAPE:RST 28H      ;clear screen
OF1B 06 02              LD B,02H      ;set B = 2
OF1D 21 50 0C           LD HL,0C50H   ;start address
0F20 C5            TREP:PUSH BC       ;save counter
0F21 06 0F              LD B, 0FH     ;set B = 15
0F23 11 90 0B      TAGAIN:LD DE,0B90H ;bottom of
                                      screen
0F26 EF 1F 00           RST 28H       ;scroll
```

```
0F29  3A C9 0E          LD A,(0EC9)     ;dump tape
                                        identifier
0F2C  CD3B 01           CALL CRT        ;display it
0F2F  7E                LD A,(HL)       ;dump tape
                                        number
0F30  CD44 02           CALL B2HEX      ;display it
0F33  23                INC HL          ;move pointer
0F34  C5                PUSH BC         ;save counter
0F35  01 14 00          LD BC,0014H     ;set BC = 20
0F38  ED B0             LDIR            ;transfer tape
                                        contents
0F3A  C1                POP BC          ;restore
                                        counter
0F3B  10 E6             DJNZ,TAGAIN     ;repeat 15
                                        times
0F3D  CD3E 00           CALL CHIN       ;wait for key
                                        depression
0F40  C1                POP BC          ;restore
                                        counter
0F41  10 DD             DJNZ,TREP       ;repeat 2 times
0F43  EF 1E 00          RST 28H         ;clear screen
OF46  AF                X0R A           ;clear A
0F47  C9                RET             ;return
0F48  21 3C 0C    PLACE:LD HL,0C3CH     ;start address
0F4B  11 B2 0E          LD DE,0EB2      ;end address
OF4E  3E 1A             LD A,1AH        ;set up A
0F50  CD9D 0F           CALL FIND       ;find empty
                                        tape
0F53  FE 00             CP A,00H        ;was there a
                                        tape free?
0F53  C8                RET Z           ;if not return
0F56  2B          TFREE:DEC HL          ;point to tape
                                        number
0F57  3A C9 0E          LD A,(0EC9H)    ;get tape
                                        identifier
0F5A  CD3B 01           CALL CRT        ;display it
0F5D  7E                LD A,(HL)       ;dump tape
                                        number
0F5E  CD44 02           CALL B2HEX      ;display it
0F61  CDDB01            CALL INLINE     ;monitor serial
                                        input
0F64  01 14 00          LDBC,0014H      ;set BC#20
0F67  11 4E 0B          LD DE,0B4EH     ;pointer after
                                        " "
0F6A  23                INC HL          ;increment
                                        pointer
0F6B  EB                EX DE,HL        ;exchange
                                        pointers
0F6D  ED BO             LDIR            ;transfer 20
                                        characters
0F6F  21 CA0E           LD HL,0ECAH     ;load update
                                        indicator
0F71  36 01             LD(HL),01       ;set dump
                                        required
0F73  AF                X0R A           ;clear A
0F74  C9                RET             ;return
0F75  13          FREE:INC DE           ;move pointer
0F76  CD5A 02           CALL NEXNUM     ;read a hex
                                        number
0F79  3A 13 0C          LD A,(0C13H)    ;dump tape
                                        number
0F7C  21 3B 0C          LD HL,0C3BH     ;set up
0F7F  11 B1 0E          LD DE 0EB1H     ;pointers
0F82  CD9D 0F           CALL FIND       ;find required
                                        tape
0F85  FE 00             CP A,00H        ;was it found?
0F87  C8                RET Z           ;if not return
0F88  23        TAPEREQ:INC HL          ;move pointer
0F89  36 1A             LD(HL),1AH      ;dump free
                                        indicator
0F8B  06 13             LD B,13H        ;set B = 19
0F8D  23        TAPEREQ1INC HL          ;move pointer
0F8E  36 20             LD(HL),20H      ;dump space
                                        character
0F90  10 FB             DJNZ,TAPEREQ1   ;repeat 19
                                        times
0F92  21 CA0E           LD HL,0EACH     ;dump required
                                        indicator
0F95  36 01             LD(HL),01       ;set indicator
0F97  EF 4F 4B 00       RST 28H         ;"OK"
0F9B  AF                X0R A           ;clear A
0F9C  C9                RET             ;return
0F9D  01 15 00    FIND:LD BC,0015H      ;set up skip
                                        number
0FA0  09          FIND1:ADD HL,BC       ;move pointer
0FA1  BE                CP A,(HL)       ;is it what's
                                        required?
0FA2  28 10             JRZ,FOUND       ;if yes, jump
0FA4  B7                OR A           ;clear flags
0FA5  ED 52             SBC HL,DE       ;if end of
0FA7  19                ADD HL,DE       ;table not
                                        required
0FA8  38 F6             JRC,FIND1       ;try again
0FAA  EF 4E 4F 20       RST 28H         ;otherwise
                                        failed
0FAE  54 41 50 45 00                    ;message "NO
                                        TAPE"
0FB3  AF                X0R A           ;clear A
0FB4  C9          FOUND:RET             ;return
0FB5  3A CA0E     TDUMP:LD A,(0ECAH)    ;dump required
0FB8  FE 01             CP A,01H        ;indicator set?
0FBA  C0                RETNZ           ;if not return
0FBB  EF 1F 44 1F 00    RST 28H         ;scroll, "D",
                                        scroll
0FC0  CD3E 00     TREP:CALL CHIN        ;get a
                                        character
0FC3  CD3B 01           CALL CRT        ;display it
0FC6  FE 53             CP A,53H        ;wait for "S"
0FC8  20 F6             JRNZ,TREP       ;before
                                        dumping
0FCA  21 50 0C          LD HL,0C50H     ;set up
0FCD  22 0C 0C          LD(0C0CH), HL   ;ARG1 and
0FD0  21 C8 0E          LD HL,0EC8H     ;ARG2 for
0FD3  22 0E 0C          LD(0C0EH),HL    ;call to dump
0FD6  CDD1 03           CALL DUMP       ;monitor dump
0FD9  EF 1F 3E 2E 00    RST 28H         ;scroll,">."
0FDE  C9 00 00          RET;NOP;NOP     ;return
0FE1  EF 1F 43    CCOM:RST 28H          ;scroll "C?  "
0FE4  3F 20 00                          ;
0FE7  CDDB01            CALL INLINE     ;serial input
                                        from monitor
0FEA  C9                RET             ;return
0FEB  21 F4 0F    TLOAD:LD HL,0FF4H     ;return address
0FEE  22 4E 0C          LD(0C4EH),HL    ;set up
0FF1  C3 7C 03          JP LOAD         ;jump monitor
                                        LOAD
0FF4  21 69 00          LD HL,0069H     ;set up
0FF7  22 4E 0C          LD(0C4EH),HL    ;original
                                        address
0FFA  C9                RET             ;return
0FFA                    END             ;end of
                                        program
```

Amendments for T4

```
0EF6  CC0C 07           CALL ZREAD      ;monitor read
0F15  CF 00 00                          ;return to
                                        monitor
0FD6  CD00 04           CALL WRITE      ;monitor write
0FEA                    END             ;end of
                                        program
```

N.B. The above amendments must be applied if a T4 is in use. A call to T2 DUMP on a T4 system will result in the stack overwriting part of the memory from 0C00H to 0C4FH allocated to the monitor.

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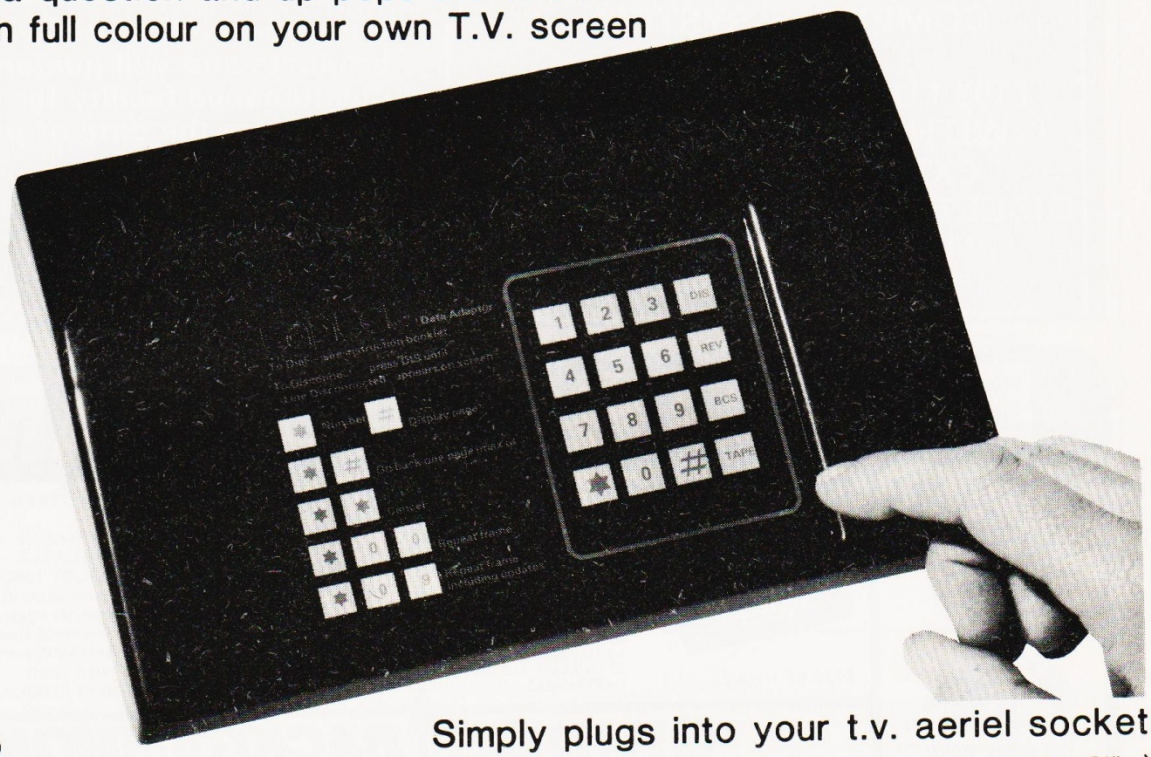

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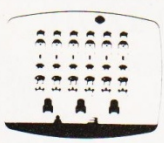

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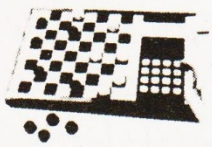

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PRINTOUT

Dear Sir,

May I point out an error in the conversion of 'Therms "T" supplied, to charges made', in WH Davies' Gas Consumption program listing.

With little or no gas used during the quarter eg (T < 52), steps 280 and 300 are enough to ignite a flaming row with your local gas board, (try it!).

May I suggest this suitable remedy:-

Delete steps 280 to 340 inclusive and insert:

```
280 L = T - 52
300 IF L>0 THEN 340
320 L = 0
340 H = T - L
345 X = H*24.6
350 Y = L*16.5
```

By the way, do check the calorific value (step 240); mine's floated up by 5 (whole things?) this quarter to 1040 (whatsits'). No doubt, all to do with the new slim-line gas stoves!

Yours sincerely,
Mr W H R Pethers.

10 Headington Close,
Wokingham,
Berks.

P.S. My apology to W H Davies for faulting, what is otherwise, a very useful program.

Dear Sir,

Many thanks for your reply to my letter about Cesil for my computer. You say that perhaps someone would convert RML 380Z Cesil for me, unfortunately I do not know anyone who has such a machine with Cesil and I wonder if you would print this letter under "Printout", so that anyone who would be willing to convert RML 380Z Cesil to TRS-80 commands could get in contact with me.

Yours faithfully,
John Herbert.

200 Hubert Road,
Selly Oak,
Birmingham B29 6ER
West Midlands.

Dear Sir,

I read with interest the letter from Mr J A Banks on page 73 of your February edition.

I have written to Mr Banks clarifying the position and I have enclosed a copy for your information. Since the facts in his letter are incorrect I will be most obliged if you could publish the following to clarify the position for your readers:-

'Since there have been a number of generations of PETs I suggest that any user considering upgrading his machine contacts his local dealer for advice. The actual details of upgrading an "old ROM" 8K machine will depend on whether that machine has "901447" or "6540" generation ROMs.

In the former case a BASIC 2.0 ROM set is, and always has been, £38 + VAT + installation and consists of a four chip set. The "6540" however, requires a seven chip set to upgrade to BASIC 2 and this set has always cost either £104 or £52 + VAT + installation, depending on whether the old ROM set is exchanged. This set is now available at £38 + VAT + installation to avoid any confusion.

Since many users became interested in upgrading their 8K's for compatibility with our disc drives we did for some time offer *free* ROM sets of either type when the user purchased our disc drive.'

I would point out that in spite of Mr Banks' comment this policy was designed to remove the necessity for our users to buy a new machine in order to upgrade their system.

I hope that the above will clarify the position for all concerned.

Yours sincerely,
Keith Hall,
Sales Manager.

Commodore Business Machines (UK) Ltd.,
818 Leigh Road, Trading Estate
Slough, Berks.

(*Thanks, hope that clears up anyone elses questions. Ed*)

Dear Sir,

Your "8K Xtra" article in the January 1981 issue of Computing Today convinced me to buy a ZX80 as it solved the major grievance I had against the machine — lack of space for machine code. However, I was somewhat confused by a few typographical errors in the article. The extra IC which is added in the circuit is described in three different places in the articles as a 74LS02, a 73LS02, and a 7402. As I do not know a great deal about IC's, I would appreciate it if you would clear up this problem by telling me exactly which IC should actually be used. Also, since the ZX80 has its own non-standard character codes, how about publishing a "graphic details" section for the ZX80?

Yours faithfully,
John TeSelle.

101 Morrell Ave.,
Oxford OX4 1NA.

(*The correct IC is a 74LS02, apologies for confusion. It is not possible to do a true "Graphic Details" for the ZX80 because it does not use a memory mapped display and therefore can't be used in the true PEEK and POKE mode. Ed*)

Dear Sir,

It has been brought to our attention that a news item published in "Computing Today" February 1981, in "Club Call" was not quite accurate. The Z80 based computer referred to has no connection with the Southampton Amateur Computer Club and is a product of Custom Design Associates of Southampton. It was, however, launched at the Club's December meeting and is being marketed by Greenbank Electronics of New Ferry, Merseyside, as the Custom 80 System, from whom full details are available.

The Custom 80 is a Z80 based computer of modular design on Eurocard plated through PCBs which provides easy expansion on a rack mountable bus. The display is Teletext and Prestel compatible in colour which is provided on-board with either Video or UHF output. Memory expansion can be achieved with 32K dynamic RAM boards which are switch selectable to any 4K boundary in 1 Mb.

We hope that this letter has clarified any confusion which might otherwise arise.

Yours faithfully,
A J Foy,

Custom Design Associates.
32 Vermont Close,
Bassett, Southampton,
Hants. SO1 7LT.

Dear Sir,

Regarding Mr Martin's letter in February's 'Printout', the following program shows RANDOMISE to be working. I too was stumped until I realised that the frame counter is not incremented while programs are running, so any attempts to compare the value of the seed set by RANDOMISE with the frame counter during the running of a program are doomed to failure. This program avoids the problem by artificially incrementing the frame counter one frame at a time.

```
 10 PRINT "FRAME COUNTER","SEED"
 20 PRINT
 30 PRINT "MSB", "LSB", "MSB", "LSB"
 40 PRINT
 50 GOSUB 130
 60 POKE 16415,0
 70 FOR A=1 TO 18
 80 POKE 16414,A
 90 IF A>9 THEN RANDOMISE
100 GOSUB 130
110 NEXT A
120 STOP
130 FOR B=0 TO 3
140 PRINT PEEK(16415-B),
150 NEXT B
160 RETURN
```

The first line of output shows the state of the frame counter and the seed as the program starts. The first nine times through the A loop RANDOMISE is not called and the value of the seed should be unchanged for the next nine lines of output as the frame counter advances. The next nine times through the A loop RANDOMISE should read the contents of the frame counter into the field holding the seed and for the last nine lines of output the values of frame counter and seed should advance together.

Yours faithfully,
Paul Duckett.

14 North Court,
Hassocks,
West Sussex.

Dear Sir,

I was pleased to see my article "Joystick Controls" in your Feb 81 issue, however the program listing seems to have developed an extra black hole, namely from location 0E9E to 0EB1. These should be :-

```
0E9E   77          LD(HL)A
0E9F   23          INC HL
0EA0   22 18 0C    LD(0C18)HL
0EAA   EF 20 69 73 20 64 65
0EAA   73 74 72 6F 79 65 64
0EB1   00
```

Also, you failed to mention that the test routine uses port A only, therefore each joystick must be connected in turn to port A for calibration. Incidentally, it is possible to use 100k joystick pots in the circuit simply by doubling the value of C2.

Apart from this, you're doing a grand job! Keep it up.

Yours faithfully,
R A E Milton.

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Folkestone,
Kent.

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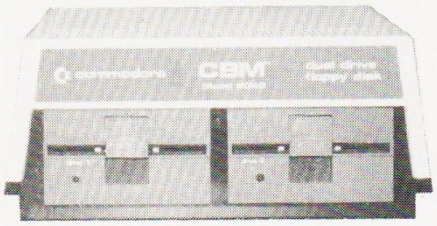

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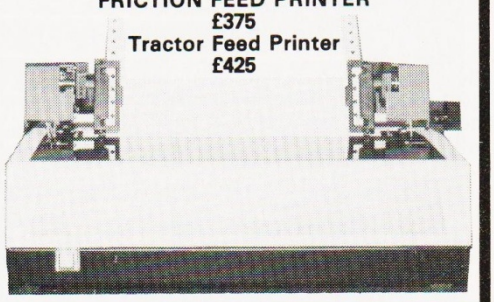

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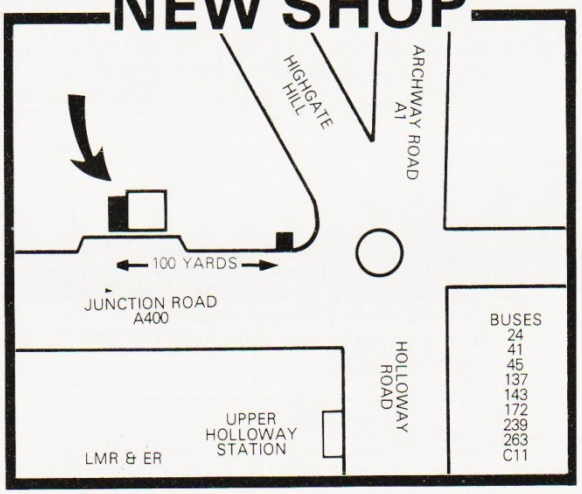

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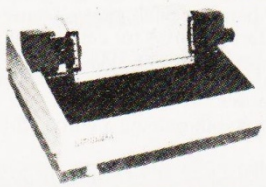

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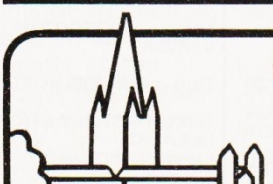

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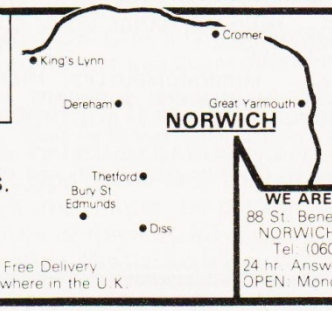

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6502 PROGRAMMING COURSE

A P Stephenson

In our second installment we look at the 6502's powerful addressing capabilities.

Having taken a look at the internal structure of the 6502 in last month's article, it is now time to plunge in with the instruction set. It is certainly worth keeping the page open at the list of instructions that we printed because we'll be referring to it from time to time.

Addressing Modes

Let's start with the top row of the "6502 Machine Code" and note that the first three letters in the mnemonic code are LDA. LDA means "LoaD Accumulator". The remaining letters (if any) determine the meaning to be attached to the operand, in other words, the kind of addressing mode. Since LDA is probably the most overworked of the machine codes it is wise to take this as an example for defining the various addressing modes.

LDA — Implies that the operand is a two-byte address, called Absolute Addressing. Example: LDA 3A 03 would cause the contents of address 033A to be copied into the Accumulator. Note carefully that the *lower* order byte of the address is written first . . . the bytes are back to front! This is an annoying quirk of the 6502 which we have to live with.

LDAZ — Implies that the operand is a single-byte address, called Zero Page Addressing. The term "Zero Page" refers to the first 256 addresses from 0000 Hex to 00FF Hex. In zero page addressing, the two leading zeros can be dropped enabling a single byte operand to be used. Example: LDAZ 4B would cause the contents of address 004B to be copied into the Accumulator. The advantage of using this addressing method is execution speed and the saving of one byte in the instruction. Unfortunately, most of page zero in the PET and the Apple/ITT has been used by the BASIC Interpreter for its working space.

LDAIM — Implies that the operand is the data . . . memory is not involved. It is called Immediate Addressing because the data is immediately available. Example: LDAIM 03 will load the Accumulator with the number 3.

LDAX — Implies that the operand is a two-byte address indexed by X. The term "indexed" means that the contents of the Index Register are added to the operand *before* the instruction is obeyed. Example: LDAX 56 34. Assume the Index Register X contains 03, the instruction will place a copy of the address 34 59 into the Accumulator. Remember that a two byte instruction is written back to front otherwise it will be difficult to follow the previous example.

LDAY — Similar to LDAX except that Index Register Y is used.

This completes the definitions of the address modes applicable to the LDA family shown in the first row of the code table. As previously mentioned, the examples applied to LDA but a glance down the code table shows that a certain similarity exists on horizontal lines for the top fourteen rows (from LDA down to CMP). It is therefore unnecessary to wade through all the addressing modes for each of these instructions since, with a few exceptions, they apply to all of them.

STA — This means STore the Accumulator contents in the address defined by the operand. Note that Immediate addressing is not available in STA.

ADC — This means "ADd with Carry". The contents of the address defined by the operand is added to the existing contents of the Accumulator. The "carry" is a single bit which is situated in the Status Register. This bit is a "1' or "0" depending on the result of a previous arithmetic instruction and is taken into account with an ADC instruction.

SBC — Means "SuBtract with Carry" and causes the contents of an address defined by the operand to be subtracted from the existing contents of the Accumulator. Again, the carry bit (or more strictly the "borrow bit") is taken into consideration.

AND — Funny one this. It performs the logical AND between the contents of the address defined by the operand and the Accumulator with the result in the Accumulator. In logic, the output of an AND gate is a "1" only if both inputs are at "1". Study this example,

Acc after	01001101	4D Hex
Acc before	01011101	5D Hex
Operand data	11101111	EF Hex

The operand in an AND instruction is called a "Mask" because it allows a programmer to erase (clear to zero) any particular bit or bits in the accumulator *without altering the rest.* The rule is simple,

> Any "0" in the mask erases the corresponding bit in the Acc. Any "1" in the mask leaves the corresponding bit alone.

Example: Assume the Acc contains 11100110. To clear the two bits at the left use ANDIM 3F. Thus 00111111 will change the Acc to 00100110.

ORA — Another funny one. Like the AND, it is used to mess around with selected bits but in the opposite fashion. It is used to set selected bits to "1" according to the following rule:

> Any "1" in the mask sets the corresponding bit in Acc to "1". Any "0" in the mask leaves the corresponding bit alone.

Example: Assume the Acc contains 01110010. To set the leftmost bit to "1" use ORAIM 80. Thus 10000000 will change the Acc to 11110010.

ORA stands for "perform the logical inclusive OR function on the Accumulator", it behaves as if an OR gate is connected between each corresponding pair of bits.

EOR — This is funnier still. It stands for "perform the Exclusive OR" and is used to change selected bits in the accumulator. The rule being,

> Any "1" in the mask changes the corresponding bit in the Acc. Any "0" leaves the corresponding bit alone.

Example: Assume the Acc contains 00110110. To change the four left-hand bits use EORIM F0. Thus 11110000 will change the Acc to 11000110.

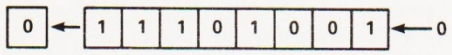
To understand this, remember that an Exclusive OR gate sets the output to "1" only if the two inputs are *different.*

Shifting It About

The next codes to attack are the four Shift type operations. To shift means to push the entire bit-pattern along a register or memory location in a certain direction. The Carry bit is also included in

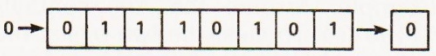
the serial chain.

ASL — This performs Arithmetic Shift Left on the Acc or memory. Best described with a diagram:



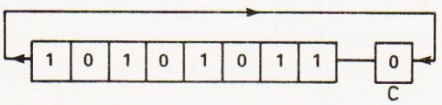
The effect of ASLA is to move the pattern along one place with a "0" moving in from the right and the end bit moving into the Carry (which is in the Status Register). Providing the sign bit is preserved it doubles the value of the byte.

LSR — This performs Logical Shift Right on the Acc or memory.

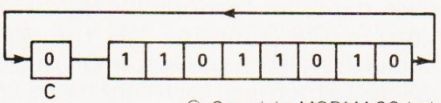


Similar to ASL but the movement is in the opposite direction.

ROL — This performs ROtate Left on the Acc or memory. Sometimes called "End around shift".



ROR — This performs ROtate Right on the Acc or Memory. End around shift again occurs.



Shift and rotate instructions can be used for a wide variety of operations. Routines to achieve multiplication and division, simulating the equivalent hardware shift registers to achieve parallel to serial or serial to parallel conversion, re-arranging data within memory etc etc.

INC — This means INCrement (add 1) the contents of memory. Surprisingly, the 6502 doesn't allow us to increment the Acc.

DEC — This means DECrement (subtract 1) the contents of memory . . . again not the Acc.

CMP — This will CoMPare the data defined in the operand with the Acc contents and then "inform" the Status Register of the result. The comparison operation is carried out in separate registers by subtracting the operand data from the Acc data. The original data in both the Acc and operand are not altered in any way. The result of the subtraction either,

a) sets the Z bit to "1" if the result was zero (data the same)
b) sets the N bit to zero if result negative (operand greater than Acc)
c) sets the C bit to "1" if the operand data is less than or equal to Acc. CMP is only used prior to a conditional "branch" instruction . . . which come next.

Conditional Branches

The IF statement in BASIC has its parallel in machine language in the form of a set of branch instructions. Before going into the details of these, we must define an unusual mode of addressing in the 6502 called relative addressing. The operand is a Hex number indicating how many bytes forward or backward to branch if the condition is satisfied. This is not so easy as stating the "line number" in BASIC. Forward branches (to a higher address) are deemed to be positive: backward branches are deemed to be negative. You start counting from the byte which would have been the next IF the condition was not satisfied. Since this sounds a bit confusing to say the least, it is best described with the aid of a diagram. We shall use BNE (branch if not equal) as an example.

```
3000  BNE0A
3002  ZZ  XX  XX
3005  XX  XX
3007  XX  XX
3009  XX  XX  XX
300C  XX  XX
5000  XX  XX  XX
5002  XX  XX
5004  BNEF9
5006  ZZ  XX
```

This example shows that to branch to the byte indicated by the arrow is 10 bytes forward from the byte ZZ. The operand of the BNE is therefore 0A Hex. The numbers at the side are arbitrary addresses of the first byte in each row. Thus the byte 0A would be in address 3001 The arrow shows that the branch is seven bytes back from the byte ZZ. This means we have to calculate what is −7 in two's complement . . . F9.

For the benefit of those who are not too sure how to find the two's complement of a number, there are two ways, both easier than the academic "invert and add 1";
Method 1 : write down the eight-bit pattern of the positive number then starting from the right, copy up to and inclusive of the first "1" and thereafter *invert*. Then express in Hex.
Example : +7 is . . . . 0000 0111 so in accordance with above, −7 is . . . . 1111 1001 which in Hex is F9.
Method 2 : write down the positive number in Hex. Subtract this from FF and add 1.
Example : +7 in Hex is 07. FF-07 is F8 and adding the 1 makes it F9.

The different types of branch instruction will now be defined, but before this it is important to know what exactly we are testing when a "branch if" instruction is written. For example, what exactly is meant when we say "Branch is Not Equal to" (BNE)? Branch if *what* is not equal to? The implication is branch if the result of the last operation resulted in zero.

Thus, if the last operation was, say an LDA, the branch would take place only if the Accumulator was left holding zero. If the last operation was LDX, the branch is dependent on whether the Index register was left with zero. If the branch condition is not satisfied, the branch operand is ignored . . . same as in BASIC. The Compare (CMP) instruction must be used prior to the branch if it is required to test the contents of some specific member other than zero. There are eight branch-if type instructions in the 6502.

BPL — Branch if PLus. Remember that zero is also a positive number. The status register is examined to see if the "N" bit (negative) is "0".
BMI — Branch if MInus. This is the direct opposite test to BPL
BVS — Branch if oVerflow Set. If the last operation caused arithmetic overflow, the "V" bit is set to "1" and it is this bit which is being tested
BVC — Branch if oVerflow Clear. Opposite effect to BVS.
BCC — Branch if Carry Clear. Tests the last operation for a carry-out condition ("C" bit set to "1"). It is a strange property of two's complement arithmetic that overflow and carry-out conditions are *not* the same.
BCS — Branch if Carry Set. Opposite effect to BCC.
BNE — Branch if Not Equal to zero. Tests the "Z" bit.
BEQ — Branch if EQual to zero. Opposite to BNE.

Status Symbols

The next set of instructions are those which do things to the status register. Although this register has previously been introduced, it's worth discussing it again in detail. It contains a collection of flag bits, a "flag" being a single bit "indicator" that a certain state exists in the computer. A flag bit at "1" indicates "yes, the condition exists". There are

seven conditions flagged in the 6502 and are illustrated below:

N	V		B	D	I	Z	C

FLAG
N..... SET TO "1" IF THE LAST OPERATION RESULTED IN A NEGATIVE VALUE
V..... " " " " " " " " " " " "OVERFLOW
Z..... " " " " " " " " " " " "ZERO
C..... " " " " " " " " " " " "A CARRY OUT
B..... " " " " " " " " WAS A BRK

All the above have one thing in common; they are set *automatically* by the computer as appropriate. With the exception of the B bit, they can also be set or reset by the programmer. It is advisable to set C to "0" before an addition and to "1" before a subtraction. The remaining bits can *only* be set or reset by the programmer:

I . . . This is the Interrupt Inhibit (sometimes called the interrupt mask). It is possible to arrange a system such that a peripheral can "request" to be allowed to interrupt the present program and borrow the computer to operate its own special program. The request is granted providing the I bit is at "0": if at "1" it is denied and the peripheral must wait patiently until it is cleared. The writer of the main program will set I to "1" at the head of any segment which can tolerate an interrupt (such as a timing loop) and clear it to zero at the end of the segment.

D . . . This is used to set Decimal mode operation. Normally, a computer forms arithmetic in two's complement because it is the most efficient in terms of execution speed and memory economy. There are certain situations, however, in which such arithmetic is not convenient. Many test instruments and other digital electronic black boxes operate in BCD (Binary Coded Decimal) which represents numbers as a four-bit group. Each group is a decimal digit in binary format, 0000 to 1001. The groups 1010 to 1111 are not used and, in fact, are illegal combinations. To illustrate, the decimal number 35 would be represented in BCD by 00110101: note that two's complement systems would recognise the pattern as +53. It is easy to see that a different kind of arithmetic adder is required to handle BCD addition (and subtraction) or at least some extra bits and pieces are required. If the programmer wishes to use BCD arithmetic the D bit is set to 1. Once this is set, the computer operates its arithmetic in this mode (including the results) until the D is set back to zero. The instructions (all single byte instructions) to mess about with the Status Register are:

CLC — CLears Carry bit to zero.
SEC — Sets carry bit to "1".
CLI — CLears Interrupt inhibit to "0" (allows interrupt).
SEI — SEts Interrupt inhibit to "1" (disallows interrupt).
CLD — CLears Decimal mode (computer arithmetic is "normal")
SED — SEts Decimal mode.

Transfers

There are six useful little instructions which enable the contents of one register to be copied into another, all of them being single byte instructions.

TAX — Transfer Acc to index register X.
TXA — is the opposite way round.
TAY — Transfer Acc to index register Y.
TYA — is the opposite way round.
TSX — Transfer Stack pointer to index register X.
TXS — is the opposite way round.

Because there is only one Acc in the 6502, these transfers are in continuous use and much "to-ing and fro-ing" goes on during the course of a program.

The Pointer And The Stack

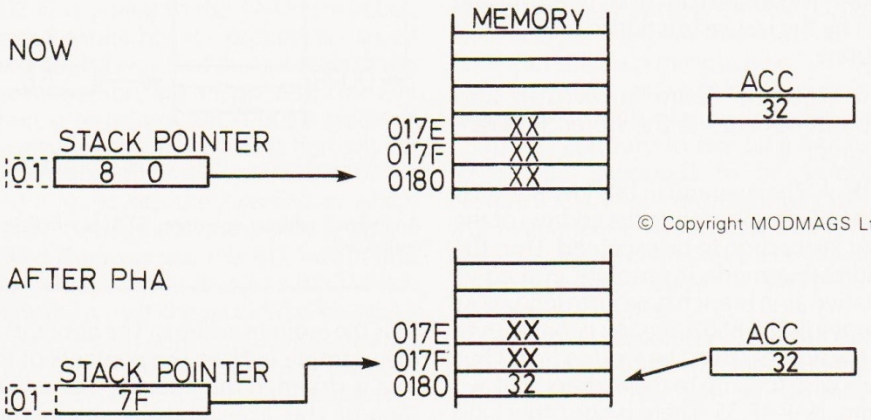
The term "Stack" is used to describe a set of memory locations obeying the rule "Last In First Out", sometimes called a LIFO stack. The first question which arises is . . . whereabouts in memory is this stack? In the case of the 6502 the answer is anywhere within the address range 0100H to 01FFH which is defined as "Page 1" (a "page" of memory in 256 bytes, the first being Page 0 from 0000 to 00FF Hex). Within the limits of Page 1, the programmer can define the beginning of the stack by loading a number into the special register called the Stack Pointer. It is called a pointer because its contents are the address of the *current* location in the stack . . . it is an indirect address.

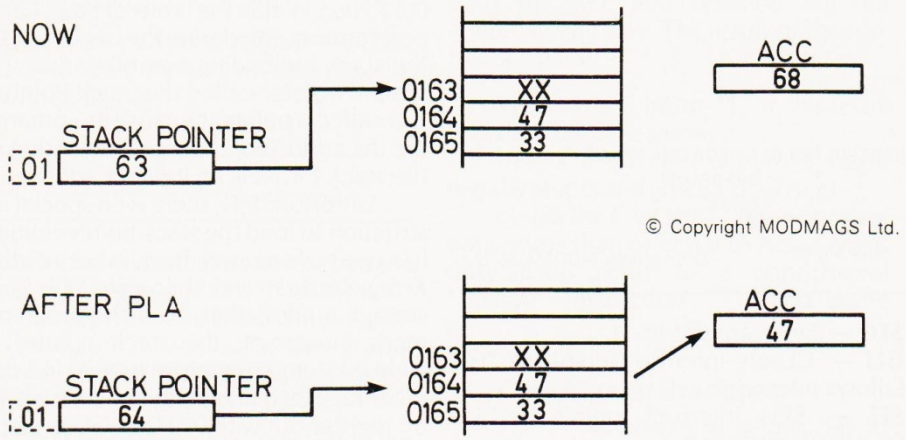
Unfortunately, there is no special instruction to load the stack pointer initially so we have to load the number into the X register first and then use TXS. One storage quirk is that from the programmer's viewpoint, the stack pointer is eight bits long so it can be treated like the other registers. In fact, the pointer is a 16 bit register but with 01 Hex *always* stuck in the higher order byte. This enables us to use a single byte register to load it with a Page 1 address. Thus if we want to set up a stack starting at address 0180 Hex, we only need to bung 80 in X and then use TXS. Well now, having set up this stack how do we use it? There are two delightfully simple instructions (only one byte long each) which enable us to push the Acc into the stack or to pull from the stack to the Acc.

PHA — This means PusH Accumulator on to stack. The action is as follows. The Acc contents are pushed into memory at the address which is currently in the Stack Pointer. The Stack pointer is then decremented by 1 so it is now pointing to the *next* vacant location.

PLA — This means PulL Accumulator from stack. The action is the reverse of the above. The Stack Pointer is first incremented to point to the address of the last data item stored. The Acc is then loaded with the contents of the address currently in the stack pointer.

Data in the stack is like a pile of plates being loaded one on top of the other and taken off again in the reverse order, thus the term Last In First Out. The following diagram may help in understanding the stack operations. Garbage contents are represented by crosses.





The previous pair of diagrams and the two above show the action of "pushing" Accumulator contents onto the stack and "pulling" them off.

It is also possible to push and pull the Status Register on and off the stack:

PHP — PusH Processor status register on to stack.
PLP — PulL Processor status register from stack.

The stack action is exactly the same as described with PHA and PLA respectively. Apart from its use as a programmable store, the stack is used automatically by subroutine instructions to store the return address.

Subroutines And Interrupt Routines

As in BASIC, it is possible to go to, and return from, subroutines.

JSR — The operand is a two byte absolute address where the start of the subroutine is located. It means Jump to SubRoutine.

RTS — This is a single byte instruction meaning ReTurn from Subroutine and will be the last instruction in a subroutine. Equivalent to RETURN in BASIC.

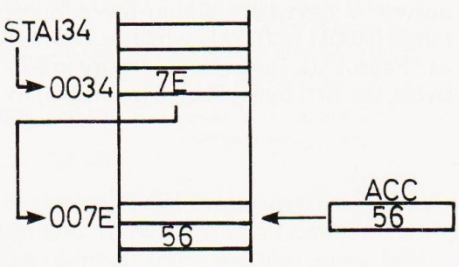
RTI — Means ReTurn from Interrupt and will be the last instruction in an interrupt routine.

The returns from interrupt and subroutines are via the stored Program Counter.

JMP — The operand in this instruction is two bytes representing the address of the next instruction to be executed. Thus the addressing mode is absolute instead of relative as in branch type instructions. As always in the 6502, the *lower* order byte of the address must be written first. Thus if we wish to jump to the address 354F we write, JMP 4F 35. There is one other kind of jump, JMPI which employs a powerful but difficult concept called indirect addressing which we must now tackle.

Indirect Addressing

This method of addressing was deliberately left until last because it is not the easiest of subjects to understand. There are quite a few of the instructions discussed already which may use indirect addressing and can be identified in the machine code table by the presence of the letter I in the mnemonic code. Thus LDAIX,STAIY etc etc. all imply that indirect addressing is used. First the definition. An indirect address is the address of an address! To illustrate a fictitious instruction STAI will be used. Suppose we write STAI 34. The computer would go to the address 34 and interpret the contents as the address of the location where the data can be found . . . . in other words 34 is an indirect address. A diagram may help:



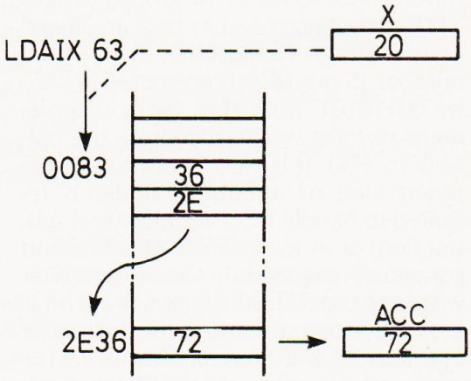
An indirect address operation, STAI is a ficticious command.

34 is the indirect address. The contents in the example is 7E so the contents of the Acc is stored in this address. The advantage of this apparently needless complication is the ability of the indirect address to be changed. Thus by changing the contents of address 0034 the original instruction STA 34 could store the Acc in an entirely different address. The contents of 0034 is said to be a *pointer* so by changing the pointer, the effective address is changed.

The above description of indirect addressing is, in the case of the 6502, a little over-simplified because it uses two variants which bring in the index registers X or Y. These variants are called Pre-Indexed Indirect (also called Indexed Indirect) and Post Indexed Indirect (also called Indirect Indexed). Refer back to the Machine Code Table and note that eight different instructions can use Indexed Indirect, all of which make use of the index register X. Another eight use Indirect Indexed which make sure of the index register Y. Note that they are all two-byte instructions which means the operand is only one byte and can only refer to Page Zero, the indirect addresses *must* all be within Page Zero! The pointers in these Page Zero addresses are, however, two bytes in length, the first being the lower order byte and the next the higher order byte. This means that the instruction using indirect addressing, although only a single byte operand, can effectively address anywhere in the 64K memory map.

A detailed definition of the sixteen indirect instructions is not necessary because of the group similarity in each eight. It will be sufficient to define LDAIX and LDAIY as representative of each group.

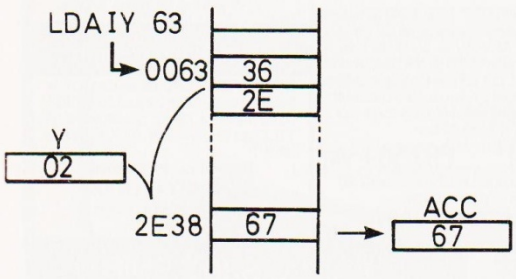
LDAIX — Means LoaD Acc using Indexed Indirect addressing. The operand the current contents of X are first added together. The result is interpreted as the address of the lower order byte of the



Loading the Accumulator using an Indexed Indirect address.

pointer, the higher order byte is the adjacent address.

LDAIY — Means LoaD Acc using Indirect Indexed addressing. The operand is the address of the lower order byte of the pointer, the higher order byte is adjacent. The index register Y is now added to the pointer and the result is the address of the data to be loaded.



Loading the Acc with an Indirect Indexed instruction.

Because of the difficult concepts inherent in the previous description, it may be helpful to summarise the main points of indirect addressing.

1. The presence of "I" in the mnemonic code indicates Indirect addressing.
2. The single byte operand is not the address of the required data. It is the address in Page 0 where the address of the data required is stored.
3. The pointer is a two byte address, and the operand of the instruction is the address of the first byte (the lower order byte).
4. Simple indirect addressing is not available in the 6502. This gives rise to two variants of indirect action, called Indexed Indirect and Indirect Indexed. (Some writers refer to these under the alternative titles of "Post-Indexed Indirect" and "Pre-Indexed Indirect" respectively).
5. Indexed Indirect uses the X index register. The operand added to the contents of X is the address in Page 0 of the pointer, (the indexing is used first).
6. Indirect Indexed uses the Y index register. The contents of Y is added to the pointer to obtain the address of the data, (the indexing is used afterwards).

These two addressing modes have enormous power and flexibility because the pointer can be modified and the index registers modified within a loop. Unfortunately, for PET owners the requirement that the pointers be stored in Page 0 severely restricts the use of these instructions because the BASIC Interpreter uses nearly all of these addresses for itself. Study of the PET Manual reveals that some of them have "no defined function" but this does not necessarily mean that BASIC doesn't use them.

Odds And Ends

There remain a few odds and ends left to clear up.

NOP — means "No OPeration" which to the highly perceptive reader must suggest the question . . . why the devil do we ever want it if it doesn't do anything? In fact all it does is to add one to the Program Counter so the machine virtually ignores it and carries on to process the next byte. Nevertheless some programmers (me included) when battling with machine code often "forget" to include an instruction. This omission is often noticed during the first abortive attempt to run the wretched program. Unlike BASIC, the luxury of slipping in the missed line by simply typing it in at the bottom is denied us in machine code. All the subsequent code has to be re-entered . . . a *most* enjoyable experience! However, by getting into the habit of slipping in a line of three NOPs about every twenty lines, they do no harm (apart from the odd sneer from the professionals) and can be overwritten with the coding that you missed.

BRK — This is equivalent to STOP in BASIC. Don't forget to stick this in at the end of your program or the machine will carry on trying to execute the following coding . . . and because the wretch has a mean temperament it will nearly always find a particularly delicate morsel of garbage which will crash the program for you.

BIT — means literally "test the bits". This has been left until last because I forgot it. This is disgraceful really, because it is an extremely useful instruction and, to some extent, exclusive to the 6502. It is similar to the AND instruction treated earlier but the process is carried out in such a way that the contents of the Acc or memory are not altered. The only effect is to inform the status register of the result. Thus if we wish to find out if a certain bit in memory is a "1" or a "0" we load a mask into the Acc first in which every bit except the one we are testing is a "0". Then we use the BIT instruction and follow it with a BNE or a BEQ which will inform us if the particular bit was a zero or not. An additional bonus offered is that bit six of the data being tested is passed to the V bit in the status register. Thus if this is followed by a BVS or BVC the state of bit six can be known. The addressing modes available are Zero Page and Absolute.

Final Warning

These notes began with a warning about the difficulty of programming in machine code and, frankly, looking back on what I have written already, the entire subject appears to be fraught with peril . . . I've got a job to understand some of it myself! However, it is worth having a bash at, if only to cultivate an air of superiority over the "stuck with BASIC" types. The great thing is to try out simple little routines first. Be content with say printing the letter "Z" at some particular point on the screen . . . even this requires some thought. Try putting some numbers in the registers and then changing them. Then progress to a simple loop counter which uses indexed addressing. Try and use one or two of the existing subroutines in the BASIC ROM. Don't overdo it 'though, or your program will not be yours at all; it will be a plagiarized hotch-potch of other people's ideas, strung together like a software necklace. One little tip, don't be in too much of a hurry to show off your machine code prowess to your "admiring" colleagues. For example, a program in machine code to print out twenty integers which you considered a triumph in the art of indexed addressing would probably invoke the response . . "is that *all* it does? You can do *that* in BASIC in one line". It's difficult to find an answer to this on the spur of the moment.

Before starting to actually write code, have a few hours practice on handling the machine code monitor (TIM on the PET). Make sure you know how to examine any block of bytes in the 64K memory map and how to change the contents with the aid of the cursor. Be extra careful with relative addresses in branch-if type instructions. If you get locked in an endless loop there is no way out except the dreaded ON/OFF switch at the rear and bang goes your code. I have noticed however that much of the code can still be in the machine . . . even after a crashed restart providing you are pretty nifty with the switch. This, of course, is contrary to teaching because RAMs are supposed to be volatile. Nevertheless, I have noticed (and I speak from experience on crashes) that often, the little RAM chips have compassion and sometimes allow a short term withdrawal of power.

Our next exploratory step will be to look at some simple machine code programs and discover how all this theory turns into practice.

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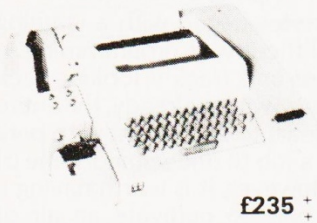


£235 + CAR + VAT

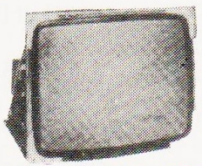
Fully fledged industry standard ASR33 data terminal. Many features including: ASCII keyboard and printer for data I/O, auto data detect circuitry, RS232 serial interface, 110 baud, 8 bit paper tape punch and reader for off line data preparation and ridiculously cheap and reliable data storage. Supplied in good condition and in working order.
Options: Floor stand **£12.50 + VAT**
Sound proof enclosure **£25.00 + VAT**

ICL TERMIPRINTER 300 BAUD TERMINALS

£325 + CAR + VAT

Made under licence from the world famous GE Co. The ICL Termiprinter is a small attractive unit with so many features it is impossible to list them in the space available! Brief spec. as follows; RS232 serial interface, switchable baud rates 110, 150, 300, (30 cps), upper and lower case correspondence type face, standard paper, almost silent running, form feed, electronic tab settings, suited for word processor applications plus many more features. Supplied in good condition and in working order. Limited quantity.

SCOOP PURCHASE 12" VIDEO MONITORS



CONNECT DIRECT TO YOUR MICRO

Made by the "BALL MIRATEL" CORPORATION USA the CD12 is a self contained, mains powered chassis professional monitor. All controls are inbuilt on a single PCB with exception of the brightness control which can be brought out for external use. Many features such as composite video, quoted bandwidth of 19 Mhz, superb linearity and definition make this a must for any MICRO/CCTV application.
Brand new and boxed only + carriage **£7.50 + VAT.** **£97.50 + VAT**
Input harness, brightness pot and connector **£2.50 + VAT.** Dimensions 9"H × 11"D × 11½"W
HURRY WHILE STOCKS LAST

EX STOCK SOFTY

EPROM BLOWER

Software development system invaluable tool for designers, hobbyists, etc. Enables open heart surgery on 2716, 2708 etc. Blows, copies, reads EPROMS or emulates EPROM/ROM/RAM in situ whilst displaying contents on domestic TV receiver. Many other features. **£115 + carr. + VAT.** Optional 2716, 2716 Function Card **£40 + VAT.** PSU **£20 + £1.50 carr. + VAT.**
Write or phone for more details.

STATIC 3K × 8 RAM CARDS

BRAND NEW PCB organised as a 3K × 8 page memory with 24 socketed 2102-L 650ns Rams, 4 Eprom Sockets and 16 TTL Chips for decoding. All IC's guaranteed.
Complete with circuit only
£24.50 + £1.75 P.P.
Dimensions 264 × 195mm.
0.1" connector.

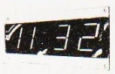
EQUIPMENT CASES

GIVE YOUR M.P.U. A HOME ONLY **£9.95** + 1.85 pp

Superb professional fully enclosed, made for the G.P.O. to the highest standard, offered at a fraction of their original cost they feature aluminium sides, hinged removable front panel, which can be secured by 2 screws to prevent prying fingers. All are finished in two tone G.P.O. grey and although believed brand new may have minor scuff marks/scratches due to bad storage.
Dimensions 16"D × 6½"H × 14¾"W

NATIONAL MA1012 LED CLOCK MODULE

★ 12 HOUR
★ ALARM
★ 50/60 HZ



The same module as used in most ALARM/CLOCK radios today, the only difference is our price! All electronics are mounted on a PCB measuring only 3" × 1¼" and by addition of a few switches and 5/16 volts AC you have a multi function alarm clock at a fraction of cost. Other features include snooze timer, am pm, alarm set, power fail indicator, flashing seconds cursor, modulated alarm output etc. Supplied brand new with full data only
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50 + BAG **£2.95** 100 + BAGS **£5.15**

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10kls £11.75 + pp £2.25 **20kls £19.99 + pp £4.75**

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STEP INTO THE 80's EX STOCK

WITH TOMORROW'S WORLD TECHNOLOGY TODAY
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PRESTEL – VIEWDATA ADAPTOR

At last this amazing piece of micro technology is available at a price you can afford. Just connect to the aerial socket of any colour or black and white domestic TV receiver and to your Post Office installed jack socket and you are into the exciting world of **PRESTEL**. Via simple push button use you are able to view a staggering 170,000 pages of up to the minute information on many services and utilities, order goods from companies, even play games!! All this and more without ever leaving your armchair!

ONLY £170 + £1.75 carr + VAT Send £197.50p

Note: When ordering please give the address and telephone number where the Tantel adaptor is to be used, we will arrange all details with the Post Office for installation of the jack socket (normally within 7 days).

WE'VE BOUGHT ANOTHER SHIPMENT! SAVE OVER £1300!!

DZM 180 CPS HIGH SPEED MATRIX PRINTERS

NOW ONLY £499 + Carr + VAT

This must be one of our greatest bulk deals, this fabulous printer is listed at over £1800 and judging by the construction we are not surprised. Made under license from the LOGABAX Co. the DMZ180 is an exceptionally sturdy high speed 180 cps matrix printer, capable of printing up to 132 characters per line on standard "Fan Fold" sprocket fed paper. A precision 7 × 7 matrix head using ruby bearings, gives a clear concise type font. Many other features include internal buffer for high throughput, standard ink ribbon, software controllable form and tab functions, standard "CENTRONICS" ASCII parallel interface etc. etc.
Optional extras **Floor Stand £30.00 + VAT, Paper Stand £18.00 + VAT**

DIABLO S30 2.5MB HARD DISK DRIVES

Limited quantity of these ultra high speed access hard disk drives type Diablo 30. They accept interchangeable 200 TP1 disk packs and require only a + and −15v DC supply. Fully DEC RK05 compatible, supplied second hand and in excellent condition.
Only £425 + carr + VAT
Dimensions 7"H × 17½"W × 22¾"D

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The PSU to end *all* your MPU/LAB requirements, made by "Weir" Electronics at over £200.00. The supply features full regulation, current limit, and overvoltage protection on all 7 outputs, just look at the spec.
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Brand New, Fully Tested	£59.99
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Supplied complete with circuit at only **£10.95 + £1.75pp.**
Believed working but untested, unguaranteed.

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Unless otherwise stated all prices inclusive of V.A.T. Cash with order. Minimum order value £2.00. Prices and Postage quoted for UK only. Where post and packing not indicated please add 50p per order. Bona Fida account orders minimum £10.00. Export and trade enquiries welcome. Orders despatched same day where possible. Access and Barclaycard Visa welcome.

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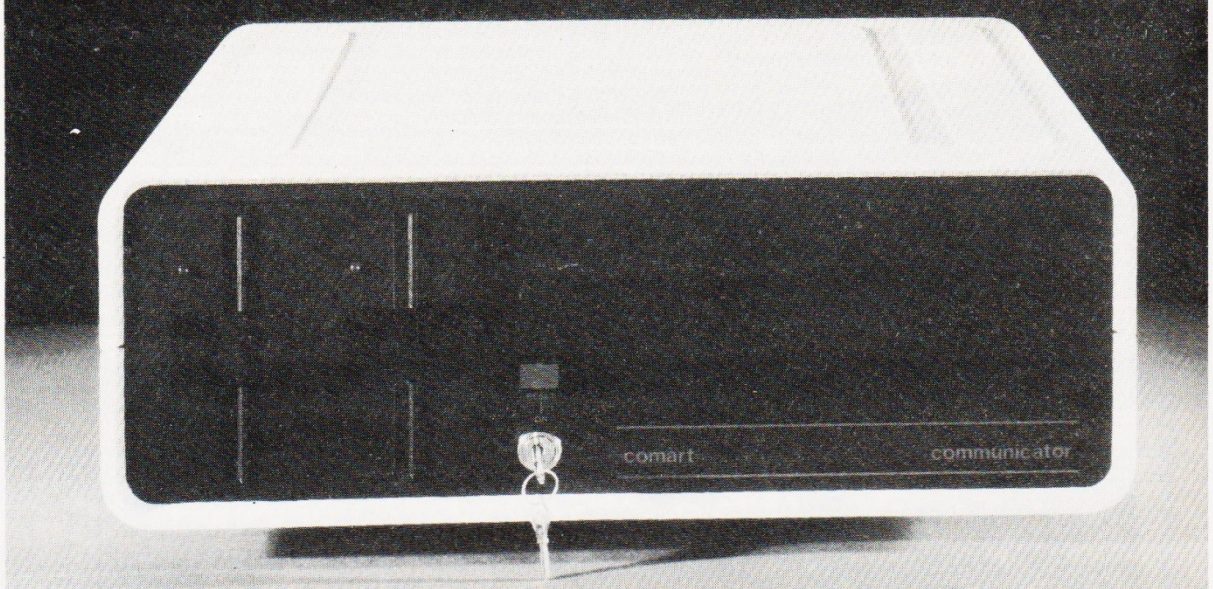
comart communicator

The clean simplicity outside...



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In this month's guide we focus on the visual aspects of peripherals.

ADDS

Regent Range
Dist. Brospa Data Ltd.,
87 Castle Street,
Reading, RG1 7ST
0734-589393

Screen size:-12"
Char. size:- —
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- Yes
No. of keys:- 77
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- V24,20mA
Baud rates:- 110-9,600
Printer port:- Yes
Light pen:- No
Other fonts:- Wide range available by switch
Price:- £560 (for Regent 25)

Options:- The Regent range comprises 5 types and covers all requirements.
Notes:- From Dumb @ £560 (Regent 25) to Smart @ £890 (Regent 60). Graphics (H.P.4010 Emulator)/Option available on all Models.

AMPEX

Dialogue 80
Dist. Brospa Data Ltd.,
87 Castle Street,
Reading, RG1 7ST.
0734-589393

Screen size:-12"
Char. size:- —
Lines x Cols:- 25 x 80
CA:- Yes
Colour:- No
Sp. Char.:- Yes
No. of keys:- 96
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- V24,20mA
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- No
Price:- £775

Options:- Key Lock Switch, 3 and 4 Pages of screen memory, 4K of key memory.
Notes:- 2 Pages of Memory as standard. Comprehensive edit, Transmission & Display facilities.

ANDERSON JACOBSON

AJ 510
Manuf. Anderson Jacobson Ltd.
752 Deal Avenue, Slough,
Berkshire SL1 4SJ
0753-25172
+ Manchester office

Screen size:-15"
Char. size:- 7 x 10
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- 41
No. of keys:- 94
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS232
Baud rates:- 110-9,600
Printer port:- Yes
Light pen:- No
Other fonts:- APL
Price:- £1,195

Options:- Full APL keyboard and character set, Overstrike.
Notes:- High quality VDU with APL capability and local printer port. Main appeal as remote terminal.

ANN ARBOR

Ambassador
Dist. IAL Digital Systems,
Midland House,
Dugal Drummond Street,
Portsmouth PO1 2BE
0705-751621.

Screen size:-15"
Char. size:- Variable
Lines x Cols:- 18-60 x 80
CA:- —
Colour:- Green
Sp. Char.:- —
No. of keys:- 94
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS232
Baud rates:- 110-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Yes
Price:- £975

Options:- Extra screen memory.
Notes:- 12 programmable function keys, keyboard selectable baud rates, detached keyboard.

BURNT HILL ELECTRONICS

BH 711
Manuf. Burnt Hill Electronics
19 Holder Road
Aldershot
Hampshire GH12 4RH
0252-313701

Screen size:-12"
Char. size:- 7 x 5
Lines x Cols:- 16 x 64
CA:- —
Colour:- Green
Sp. Char.:- —
No. of keys:- N/A
Numeric pad:- N/A
Cursor keys:- N/A
Interface:- CCITT V24,20mA
Baud rates:- 75-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- No
Price:- £656

Options:- Control and keyboard function re-assignment
Notes:- Rack mounting VDU for use with remote keyboards such as the BH 722 @ £204 or the BH 723 @ £173

BH 720
Manuf. As BH711

Screen size:-12"
Char. size:- 5 x 9
Lines x Cols:- 25 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- Yes
No. of keys:- 75
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- CCITT V24, 20mA
Baud rates:- 75-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- —
Price:- £892

Options:- Control and keyboard function re-assignment
Notes:- Free standing terminal with a number of pre-defined control functions built in.

BH 721
Manuf. As BH711

Screen size:-12"
Char. size:- 5 x 9
Lines x Cols:- 25 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- Yes
No. of keys:- N/A
Numeric pad:- N/A
Cursor keys:- N/A
Interface:- CCITT V24, 20mA
Baud rates:- 75-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- —
Price:- £862

Options:-
Notes:- Rack mount display terminal for use with remote keyboards such as the BH 722 or the BH 723

BH 912
Manuf. As BH711

Screen size:-12"
Char. size:- 7 x 10
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- —
No. of keys:- 84
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232, 20mA
Baud rates:- 75-19,200
Printer port:- No
Light pen:- No
Other fonts:- —
Price:- £695

Options:-
Notes:- Micro controlled intelligent editing terminal

BH 920
Manuf. As BH711

Screen size:-12"
Char. size:- 7 x 10
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- —
No. of keys:- 103
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232, 20mA
Baud rates:- 75-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- —
Price:- £895

Options:-
Notes:- Extended version of the BH 912 with a two page display memory.

CIFER SYSTEMS

MODEL 2602
Manuf. Cifer Systems Limited
Avro Way
Bowerhill
Melksham
Wiltshire SN12 6TP
0225-704502

Screen size:-12"
Char. size:- 7 x 11
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green optional
Sp. Char.:- Optional
No. of keys:- 62
Numeric pad:- No
Cursor keys:- Yes
Interface:- CCITT V24
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £728

Options:- Extra page memory, 20mA current loop interface
Notes:- Versatile medium priced VDU

MODEL 2603
Manuf. As MODEL 2602

Screen size:-12"
Char. size:- 7 x 11
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green optional
Sp. Char.:- Optional
No. of keys:- 62
Numeric pad:- No
Cursor keys:- Yes
Interface:- CCITT V24
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £745

Options:- As Model 2602
Notes:- Extended version of 2602 with visual highlighting and double size and flashing character capability

MODEL 2604
Manuf. As MODEL 2602

Screen size:-12"
Char. size:- 7 x 11
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green optional
Sp. Char.:- Yes
No. of keys:- 62
Numeric pad:- No
Cursor keys:- Yes
Interface:- CCITT V24
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £762

Options:- As Model 2602
Notes:- Extended version of the 2603 with overstrike graphics giving line drawing facilities

MODEL 2605
Manuf. As MODEL 2602

Screen size:-12"
Char. size:- 7 x 11
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green optional
Sp. Char.:- Optional
No. of keys:- 102
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- CCITT V24
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £829-862

Options:- Extra screen memory, 20mA current loop interface
Notes:- Full feature editing terminal with 25th status line display and a variety of display options

MODEL 2632
Manuf. As MODEL 2602

Screen size:-12"
Char. size:- 7 x 11
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green optional
Sp. Char.:- Optional
No. of keys:- 100
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- CCITT V24
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £997

Options:-
Notes:- Semi intelligent on or off-line editing terminal with a wide selection of pre-programmed functions

MODEL 2652
Manuf. As MODEL 2602

Screen size:-12"
Char. size:- 7 x 11
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green optional
Sp. Char.:- Optional
No. of keys:- 100
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- CCITT V24
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £963

Options:-
Notes:- Fully DEC VT52 compatible unit with several extra features taken from the 2605

DACOLL

MODEL 242-3
Manuf. Dacoll Engineering Services
Dacoll House
Gardners Lane
Bathgate
West Lothian, Scotland
0506-56565

Screen size:-12"
Char. size:- 8 x 7
Lines x Cols:- 25 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- –
No. of keys:- 82
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- CCITT V24, 20mA
Baud rates:- 110-9600
Printer port:- Yes
Light pen:- No
Other fonts:- –
Price:- £600

Options:- 132 columns. Second page memory, Full editing
Notes:- Versatile unit capable of being configured for a number of systems such ast VT52 or VIP 7250

MODEL 246
Manuf. As MODEL 242-3

Screen size:-12"
Char. size:- 8 x 7
Lines x Cols:- 25 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- –
No. of keys:- 94
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- Special
Baud rates:- –
Printer port:- Yes
Light pen:- No
Other fonts:- –
Price:- £1,100

Options:-
Notes:- A slave VDU designed to operate with the 245 controller which allows up to 8 units to emulate a specified protocol

DIRECT

Direct VP800B
Dist. Sintrom Electronics
14 Arkwright Road,
Reading,
Berks RG2 0LS.
0734-84322

Screen size:-12"
Char. size:- 5x7 or 7x9
Lines x Cols:- 24 x 80 or 28 x 132
CA:- Yes
Colour:- Green optional
Sp. Char.:- Programmable
No. of keys:- 128
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS232
Baud rates:- 150-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Yes
Price:- £1,800

Options:- WP capability soon.
Notes:- Memory up to 34 A4 pages of text, fully software controlled, detached keyboard.

ELBIT

DS 1920
Manuf. Elbit Data Systems
295 Aberdeen Avenue,
Slough, Berks. SL1 4HQ.
Slough 26713

Screen size:-12" or 15"
Char. size:- 5 x 8
Lines x Cols:- 24 x 80
CA:- –
Colour:- –
Sp. Char.:- –
No. of keys:- 63 or 95
Numeric pad:- –
Cursor keys:- –
Interface:- CCITT V24
Baud rates:- 110-9600
Printer port:- –
Light pen:- –
Other fonts:- –
Price:- £ – unknown

Options:- 20mA current loop interface, 7 x 8 character matrix
Notes:- Basic glass teletype with some editing functions and a detachable keyboard

DS 2000
Manuf. As DS 1920

Screen size:-15"
Char. size:- 8 x 10
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green optional
Sp. Char.:- –
No. of keys:- N/A
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS232
Baud rates:- 75-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- APL
Price:- £850-900

Options:- Amber screen, APL set and keyboard.
Notes:- 48 line display memory with 1 page scrolling window or 2 pages Micro controlled terminal.

DS 376
Manuf. As DS 1920

Screen size:-15"
Char. size:- 9 x 7
Lines x Cols:- 24 x 80
CA:- –
Colour:- Green optional
Sp. Char.:- –
No. of keys:- N/A
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- –
Baud rates:- –
Printer port:- Yes
Light pen:- No
Other fonts:- –
Price:- –

Options:- Amber screen.
Notes:- Cluster terminal controller.

HAZELTINE

MODEL 1410
Manuf. Hazeltine Ltd.
292 Worton Road
Isleworth
Middlesex TW7 6EL
01-568 1851

Screen size:-12"
Char. size:- 5 x 7
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- –
Sp. Char.:- –
No. of keys:- 65
Numeric pad:- Yes
Cursor keys:- No
Interface:- RS 232
Baud rates:- 110-9600
Printer port:- No
Light pen:- No
Other fonts:- –
Price:- £475

Options:-
Notes:- Bottom of the range, no frills VDU, ideally suited to the remote user or micro owner.

MODEL 1420
Manuf. As 1410

Screen size:-12"
Char. size:- 5 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- –
Sp. Char.:- –
No. of keys:- 77

Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 110-9600
Printer port:- —
Light pen:- No
Other fonts:- Optional
Price:- £515

Options:- 20mA current loop interface, Aux I/O port
Notes:- Terminal aimed specifically at the small business and word processing end of the market. Character set has true descenders.

MODEL 1421
Manuf. As 1410

Screen size:-12"
Char. size:- 5 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- —
No. of keys:- 73
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 110-9600
Printer port:- No
Light pen:- No
Other fonts:- Optional
Price:- £515

Options:- 20mA current loop interface, Aux I/O port.
Notes:- Lear Siegler ADM 3A compatible version of the 1420.

MODEL 1500
Manuf. As 1410

Screen size:-12"
Char. size:- 7 x 10
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- —
No. of keys:- 74
Numeric pad:- Yes
Cursor keys:- No
Interface:- RS 232, 20mA
Baud rates:- 110-19,200
Printer port:- No
Light pen:- No
Other fonts:- Optional
Price:- £785

Options:-
Notes:- Unit supplied with an auxiliary port that could be used for a printer and also permits remote editing of screen data.

MODEL 1510
Manuf. As 1410

Screen size:-12"
Char. size:- 7 x 10
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- —
No. of keys:- 81
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232, 20mA
Baud rates:- 110-19,200
Printer port:- No
Light pen:- No
Other fonts:- Optional
Price:- £880

Options:-
Notes:- Screen format mode, Memory protect, Reverse video selectable and remote editing capability.

MODEL 1520
Manuf. As 1410

Screen size:-12"
Char. size:- 7 x 10
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- —
No. of keys:- 81
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232, 20mA
Baud rates:- 110-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £1,050

Options:-
Notes:- Full microprocessor controlled, buffered data entry terminal with integral local printer interface.

MODEL 1552
Manuf. As 1410

Screen size:-12"
Char. size:- 7 x 10
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- Yes
No. of keys:- 81
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232, 20mA
Baud rates:- 110-9600
Printer port:- No
Light pen:- No
Other fonts:- —
Price:- £800

Options:-
Notes:- DEC VT52 compatible terminal with several extra features.

EXECUTIVE 80-20/30
Manuf. As 1410

Screen size:-15"
Char. size:- 7 x 10
Lines x Cols:- 25 x 80 or 132
CA:- Yes
Colour:- Green
Sp. Char.:- —
No. of keys:- 108
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232/449, 20mA
Baud rates:- 110-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- From £857

Options:- Buffered printer port, 20mA interface.
Notes:- Ergonomically designed VDU with audio or tactile feedback, smooth scrolling, 2 page screen memory, separate keyboard etc.

IBM (UK) LTD.

3101
Manuf. IBM (UK) Ltd.
PO Box 41
North Harbour, Portsmouth
Hampshire PO6 3AU
0705-694941

Screen size:-12"
Char. size:- 7 x 14
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- —
No. of keys:- 87
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232/422, 20mA
Baud rates:- to 9600
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £ — TBA

Options:- A wide variety of interface options, 3102 printer
Notes:- Very high quality ergonomically designed VDU made up of three discrete units with matching printer.

LEAR SIEGLER

ADM-3A
Dist. Penny and Giles Ltd.
Computer Peripherals Division
Mudeford
Christchurch
Dorset BH23 4AT
04252-71511
UK Importer,
many other local outlets.

Screen size:-12"
Char. size:- 5 x 7
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Optional green
Sp. Char.:- —
No. of keys:- 59
Numeric pad:- No
Cursor keys:- No
Interface:- RS 232, 20mA
Baud rates:- 75-19,200
Printer port:- No
Light pen:- No
Other fonts:- Optional
Price:- £492

Options:- Remote numeric data entry pad, Auto repeat, Lower case
Notes:- Basic VDU with standard upper case only.

ADM-3A +
Dist. As ADM-3A

Screen size:-12"
Char. size:- 5 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Optional green
Sp. Char.:- —
No. of keys:- 73
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232, 20mA
Baud rates:- 75-19,200
Printer port:- No
Light pen:- No
Other fonts:- Optional
Price:- £552

Options:- Auto repeat
Notes:- De-luxe version of the ADM-3A with true lower case and integral keypad.

ADM-31
Dist. As ADM-3A

Screen size:-12"
Char. size:- 7 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Optional green
Sp. Char.:- Optional
No. of keys:- 90
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232, 20mA
Baud rates:- 50-9600
Printer port:- Yes
Light pen:- No
Other fonts:- Various
Price:- £737

Options:- Direct polling of cursor position
Notes:- Two page memory device with micro control, full editing capability and programme personality.

ADM-42
Dist. As ADM-3A

Screen size:-15"
Char. size:- 7 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Optional green
Sp. Char.:- Optional
No. of keys:- 118
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232, 20mA
Baud rates:- 50-9600
Printer port:- No
Light pen:- No
Other fonts:- Optional
Price:- £1,170

Options:- 8 page memory, Printer port, Bus interface, etc, etc.
Notes:- Three part VDU with virtually every option possible, lives up to the name of American Dream Machine, hence the initials!

LYME

MODEL 4002
Manuf. James Scott
Electronic Developments
2 Avenue Court,
Farm Avenue
London NW2
01-452 0490

Screen size:-12"
Char. size:- 12 x 7
Lines x Cols:- 24 x 80
CA:- —
Colour:- Green
Sp. Char.:- —
No. of keys:- 90
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 75-9600
Printer port:- No
Light pen:- No
Other fonts:- —
Price:- £625

Options:- See Models 4003-4006
Notes:- Two page memory terminal with integral programmable functions.

MODEL 4003
Manuf. As 4002

Screen size:-12"
Char. size:- 12 x 7
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- —
No. of keys:- 90
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 75-9600
Printer port:- No
Light pen:- No
Other fonts:- —
Price:- £625

Options:- See other models in range
Notes:- Enhanced version of 4002 with extra status line display and DEC VT52 compatability.

MODEL 4004
Manuf. As 4002

Screen size:-12"
Char. size:- 12 x 7
Lines x Cols:- 24 x 80
CA:- —
Colour:- Green
Sp. Char.:- —
No. of keys:- 90
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 75-9600
Printer port:- No
Light pen:- No
Other fonts:- —
Price:- £625

Options:- See other models in range
Notes:- Teletype or two page editing terminal configuration with block and line transmission capability.

MODEL 4005
Manuf. As 4002

Screen size:-12"
Char. size:- 12 x 7
Lines x Cols:- 24 x 80
CA:- —
Colour:- Green
Sp. Char.:- —
No. of keys:- 90
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 75-9600
Printer port:- No
Light pen:- No
Other fonts:- —
Price:- £625

Options:- See other models in range
Notes:- Data General 6053 compatible version of the 4003.

MODEL 4006
Manuf. As 4002

Screen size:-12"
Char. size:- 12 x 7
Lines x Cols:- 24 x 80
CA:- –
Colour:- Green
Sp. Char.:- –
No. of keys:- 90
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 75-9600
Printer port:- No
Light pen:- No
Other fonts:- –
Price:- £625

Options:- See other models in the range
Notes:- Hazeltine 1410 compatible version of the 4003.

MODEL 5000
Manuf. As 4002

Screen size:-15"
Char. size:- 12 x 7
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- Yes
No. of keys:- 102
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS232,20mA
Baud rates:- 75-9,600
Printer port:- Yes
Light pen:- No
Other fonts:- Yes
Price:- £745

Options:- 132 column screen, synchronous interface.
Notes:- Fully user programmable VDU with a choice of terminal emulations.

LYNWOOD

BETA
Manuf. Lynwood Scientific
Developments Ltd.,
Caker Stream Road,
Alton, Hampshire

Screen size:-–
Char. size:- 7 x 11
Lines x Cols:- 30 x 80
CA:- –
Colour:- Green
Sp. Char.:- –
No. of keys:- Choice
Numeric pad:- Optional
Cursor keys:- Optional
Interface:- V24, 20mA
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- –
Price:- £–

Options:- Choice of keyboards.
Notes:- Microprocessor controlled terminal with page memory. Slightly less sophisticated version of the ALPHA graphics terminal.

MICRO TERM

ACT-V
Dist. Strumech
Portland House
Coppice Side, Brownhills
West Midlands
05433-4321

Screen size:-12"
Char. size:- –
Lines x Cols:- 24 x 80
CA:- –
Colour:- –
Sp. Char.:- Yes
No. of keys:- 77
Numeric pad:- –
Cursor keys:- –
Interface:- RS 232
Baud rates:- 110-9600
Printer port:- –
Light pen:- –
Other fonts:- –
Price:- £ – unknown

Options:-
Notes:- Screen display can be re-configured to 48 x 39.

NEWBURY LABORATORIES

MODEL 7000
Manuf. Hazeltine Ltd.
King Street
Odiham
Hampshire RG25 1NN
025-671 2910
6 Regional sales & service centres

Screen size:-12"
Char. size:- 7 x 5
Lines x Cols:- 24 x 80
CA:- –
Colour:- Green
Sp. Char.:- –
No. of keys:- 63
Numeric pad:- No
Cursor keys:- No
Interface:- CCITT V24,20mA
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- –
Price:- £495

Options:- Model 7001 with addressable cursor and page mode @ £595.
Notes:- Microprocessor based "Glass Teletype" with 3 page memory

MODEL 7002
Manuf. As 7000

Screen size:-12"
Char. size:- 7 x 5
Lines x Cols:- 24 x 80
CA:- –
Colour:- Green
Sp. Char.:- –
No. of keys:- 74
Numeric pad:- Yes
Cursor keys:- No
Interface:- CCITT V24,20mA
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- –
Price:- £545

Options:- Model 7003 with addressable cursor and page mode @ £645.
Notes:- More sophisticated version of the 7000 with several extras like video output and numeric keypad. 3 page memory as standard

MODEL 7007
Manuf. As 7000

Screen size:-12"
Char. size:- 6 x 8
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- –
No. of keys:- 91
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- CCITT V24,20mA
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- –
Price:- £745

Options:- 25th display line, Field protect, Extra page memory
Notes:- Full editing terminal with numerous features.

MODEL 7009
Manuf. As 7002

Screen size:-12"
Char. size:- 7 x 8
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- –
No. of keys:- 91
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS232C,20mA
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- –
Price:- £795

Options:- Displayable 25th line.
Notes:- Seven page memory VDU with full screen formatting capability through keyboard and protected memory.

PENTLAND

PENTLAND Mk VIII
Manuf. CPU Computers
St. Johns,
Woking,
Surrey.

Screen size:-12"
Char. size:- –
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- –
Sp. Char.:- Yes
No. of keys:- 90
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS232
Baud rates:- 50-9,600
Printer port:- No
Light pen:- No
Other fonts:- –
Price:- £465

Options:- 20 mA current loop, Auxiliary interface.
Notes:- Newly introduced low-cost terminal.

PERICOM DATA SYSTEMS

6801
Manuf. Pericom Data Terminals
1-3 Burners Lane, Kiln Farm
Milton Keynes
Bucks MK11 38A
0908-564747

Screen size:-15"
Char. size:- 7 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- Optional
No. of keys:- 87
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 75-9600
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £985

Options:- Extra page of screen memory.
Notes:- Ergonomically designed simple editing terminal.

6802
Manuf. As 6801

Screen size:-15"
Char. size:- 7 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- Optional
No. of keys:- 131
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 75-9600
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £1,085

Options:- Extra screen memory.
Notes:- Extended version of 6801 with 24 pre-defined function keys.

6803
Manuf. As 6801

Screen size:-15"
Char. size:- 7 x 9
Lines x Cols:- 24 x 132
CA:- Yes
Colour:- Green
Sp. Char.:- Optional
No. of keys:- 87
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 75-9600
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £1,285

Options:- Extended keyboard as the 6802.
Notes:- Designed for use in the word processing market with the wide screen display which can be reset to 80 columns.

6807
Manuf. As 6801

Screen size:-15"
Char. size:- 7 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- Optional
No. of keys:- 84
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 75-9600
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £1,350

Options:- Extended keyboard.
Notes:- Fully VT100 compatible terminal with four different character formats available.

PERKIN ELMER

BANTAM 550
Manuf. Perkin Elmer Data Systems
227 Bath Road
Slough, Berks SL1 4AX
0753-34511

Screen size:-12"
Char. size:- 5 x 9
Lines x Cols:- 24 x 80
CA:- –
Colour:- –
Sp. Char.:- –
No. of keys:- 66
Numeric pad:- Yes
Cursor keys:- No
Interface:- RS 232
Baud rates:- 110-9600
Printer port:- No
Light pen:- No
Other fonts:- Optional
Price:- £550

Options:- 20mA current loop interface, Printer port.
Notes:- Glass Teletype VDU.

SUPER OWL 1245/51
Manuf. As BANTAM 550

Screen size:-12"
Char. size:- 7 x 11
Lines x Cols:- 24 x 80
CA:- –
Colour:- Optional Green
Sp. Char.:- Yes
No. of keys:- 82 or 98
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 110-9600
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £1,250

Options:- Two types of detached keyboard, Light pen.
Notes:- Block mode editing terminal with special business form character set and 25th status line.

SOROC

IQ 120
Dist. Strumech
Portland House
Coppice Side, Brownhills
West Midlands
05433-4321

Screen size:-12"
Char. size:- 5 x 7
Lines x Cols:- 12 x 80
CA:- Yes
Colour:- –
Sp. Char.:- –
No. of keys:- 74
Numeric pad:- –
Cursor keys:- –
Interface:- RS 232
Baud rates:- 75-19,200
Printer port:- –
Light pen:- –

Other fonts:- —
Price:- £ — unknown

Options:- Block mode, Printer port.
Notes:- Functional basic editing terminal.

SOUTHWEST TECHNICAL PRODUCTS

CT-82
Dist. Southwest Technical
38 Dover Street
London W1
01-491 7507

Screen size:-8"
Char. size:- 7 x 12
Lines x Cols:- 16 x 82
CA:- Yes
Colour:- Green
Sp. Char.:- Yes
No. of keys:- 68
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 50-38,400
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £700

Options:- Light pen option, Various screen formats.
Notes:- Full editing terminal for use with the SWTP micros or as a stand-alone device.

TANDBERG

TVD 2200
Dist. Farnell International
Sandbeck Way, Wetherby,
West Yorkshire LS22 4DH
0937-63541

Screen size:-15"
Char. size:- 7 x 9
Lines x Cols:- 25 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- Yes
No. of keys:- 122
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS422, V24
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Yes
Price:- £1,200 approx.

Options:- 20 mA current loop.
Notes:- Ergonomically designed VDU with detached keyboard and programmable key functions.

TELERAY

MODEL 10
Dist. Teleprinter Equipment Ltd.
Akeman Street
Tring, Herts HP23 6AJ
044282-4011

Screen size:-12"
Char. size:- 7 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- —
No. of keys:- 98
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 50-9600
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £680

Options:- Emulators for VT52, Data General and Prism.
Notes:- In common with the rest of the range the VDU has a choice of four casing options including rack-mount.

MODEL 11
Dist. As MODEL 10

Screen size:-12"
Char. size:- 7 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- APL set
No. of keys:- 98
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 50-9600
Printer port:- Yes
Light pen:- No
Other fonts:- —
Price:- £680

Options:-
Notes:- The unit is supplied with the full APL character set including all the overstrike codes.

MODEL 12
Dist. As MODEL 10

Screen size:-12"
Char. size:- 7 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- —
No. of keys:- 98
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 50-9600
Printer port:- Yes
Light pen:- No
Other fonts:- —
Price:- £870

Options:- 20mA current loop interface.
Notes:- De-luxe version of the "10" with extra programmable function space and a two page memory.

VISUAL TECHNOLOGY

VISUAL 200
Dist. Wilkes Computing Ltd.
Bush House
72 Prince Street
Bristol BS1 4HU
0272-25921

Screen size:-12"
Char. size:- 7 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- —
No. of keys:- 93
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 110-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- —
Price:- £795

Options:-
Notes:- Full feature editing VDU which is programmable to emulate Hazeltine 1500, ADDS 520, ADM-3A or DEC VT52 machines.

ZENITH DATA SYSTEMS

ZENITH Z19
Manuf. Zenith Data Systems
Bristol Road
Gloucester GL2 6EE
0452-29451
London shop — 01-636 7349

Screen size:-12"
Char. size:- 5 x 9
Lines x Cols:- 25 x 80
CA:- Yes
Colour:- —
Sp. Char.:- Yes
No. of keys:- 84
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 110-9600
Printer port:- No
Light pen:- No
Other fonts:- —
Price:- £851.25

Options:- 20mA current loop adaptor.
Notes:- Z80 based full editing terminal. The unit is also available as a 'Heathkit' to save money.

SPECIAL OFFER
PERKIN-ELMER
MODEL 550
BANTAM VISUAL DISPLAY UNIT

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Westrex Company Limited
Bilton Fairway Estate
Long Drive Greenford Middlesex
Telephone: 01 578 0950 & 578 0957/8/9

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MaricK **Dept 11, 1, Branksome Close, Paignton Devon. TQ3 1EA.**

Z-80
Books
at Microdigital

Programming the Z-80 – R. Zaks
Another in the highly successful Sybex Series by Rodnay Zaks. This book combines the function of a teaching text, that Sybex do so well, with an extensive reference section. The book is much more than an introduction to the Assembly Language syntax of the Z-80. **9.70**

Practical Microcomputer Programming with the Z-80 – Weller
18 chapters of solid accurate programming information. Debugging techniques, interrupt modes, array and table handling, number base conversation, floating point arithmetic, programmed input/output stackpointer usage. The book includes an editor assembler listing for Z-80 and 8080. If you return the coupon at the back of the book you receive either paper tape or TRS 80 cassette of the object code for the assembler. **19.50**

Z-80 Assembly Language Programming
Instruction set plus examples plus algorithms. An accurate and reliable textbook. **10.45**

Z-80 Programming for Logic Design – A. Osborne
These books describe the implementation of sequential and combinational logic using assembly language. They describe the meeting ground of the programmer and the logic designer and are written for readers in both fields. **6.25**

Z-80 Microprocessor Programming and Interfacing Volume 1 – Nichols and Rony
This book is the first of a two volume series on the Z-80. It covers programming at the assembly and machine language level for the Z-80. Book 2 will cover interfacing. The books are laboratory orientated texts. The strong emphasis is on learning through experiment. This book requires no background in computers. **7.70**

Z-80 Programming and Interfacing Book 2 – Nichols and Rony
Address interfacing digital circuits with the Z-80 CPU, P10 and CTC chip and progresses on from Book 1 (Interfacing assuming the reader is familiar with the topics covered in Book 1). **8.45**

Instruction Handbook (Z-80)
This slim volume constitutes a powerful and comprehensive guide. About seven hundred instruction codes are obtainable from the basic instructions. **3.05**

Z-80 Microcomputer Design Projects – W. Barden Jnr.
A solid introduction to the Z-80 microcomputer and the EZ-80 chip. Simple construction of the EZ-80 microcomputer and several applications. **9.10**

Z-80 Microcomputer Handbook – W. Barden Jnr.
This book provides essential information on Z-80 technology and is organised into three sections: Hardware, software and microcomputers built around the Z-80. **6.90**

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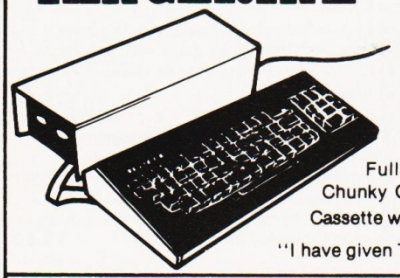

6502 Microprocessor IK Tanbug IK User RAM Full TV Display **£79** (ready-built). 20-way KEYPAD—**£10.**
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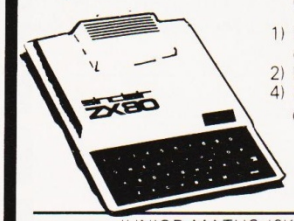

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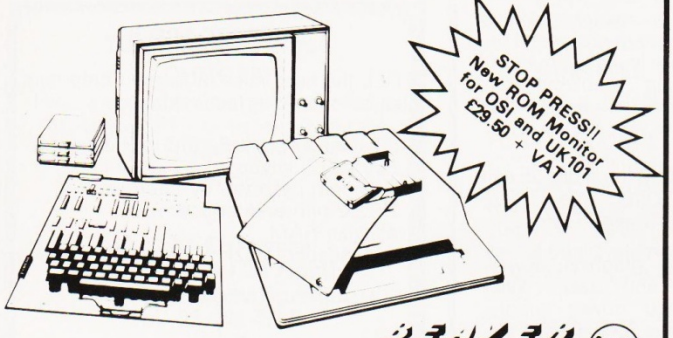

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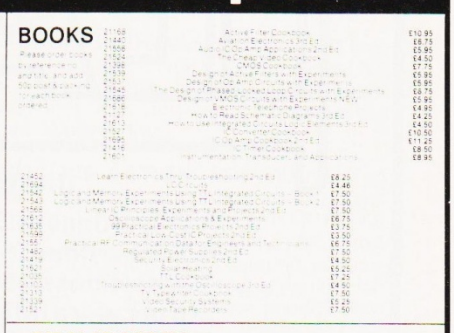

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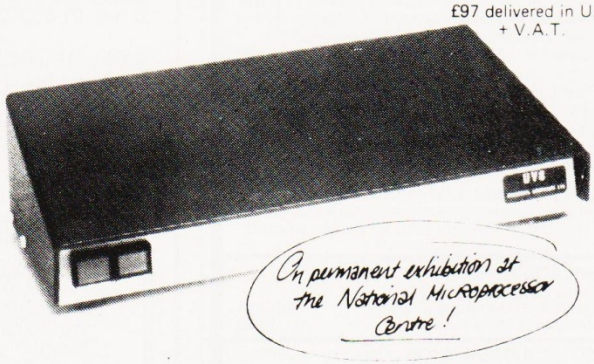

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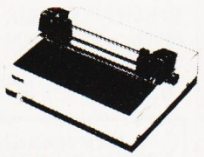

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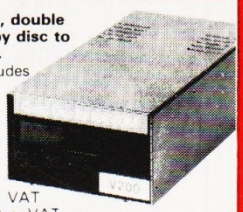

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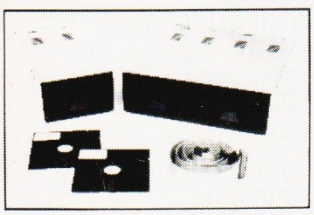

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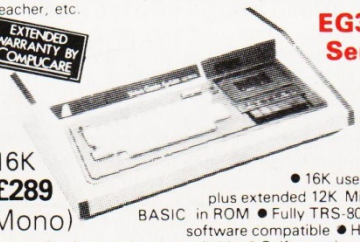

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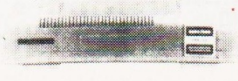

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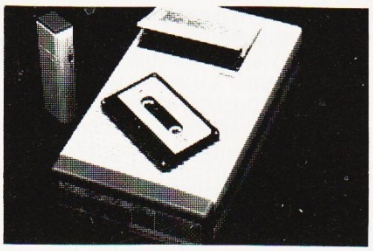

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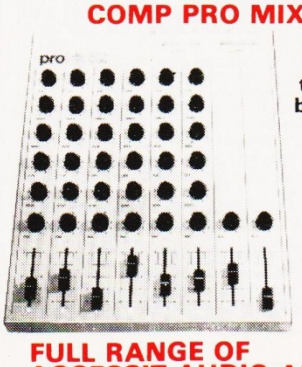

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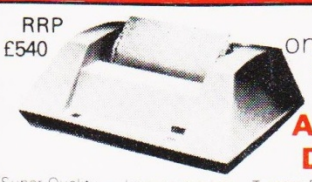

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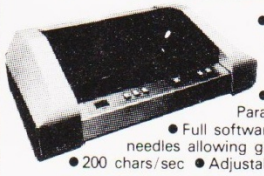

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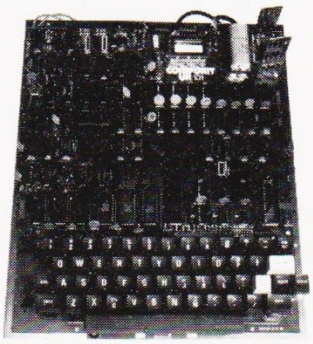

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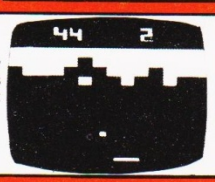

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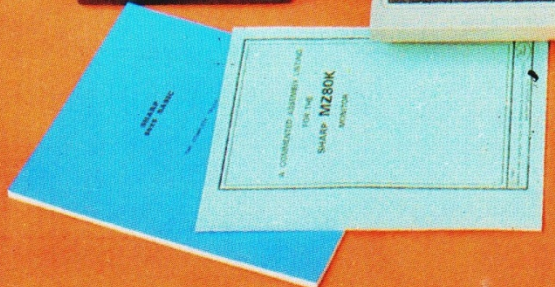

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