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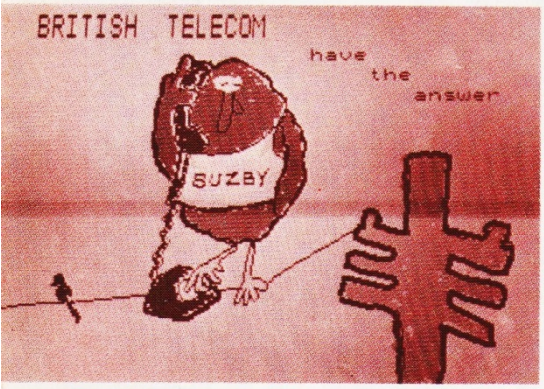

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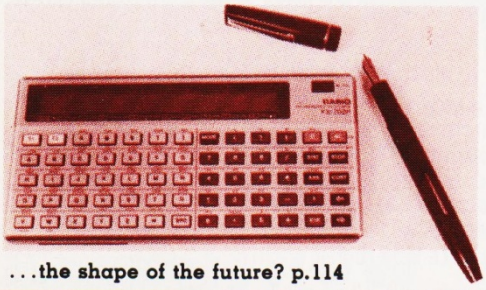

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All material should be typed. Any programs submitted must be listed, cassette tapes and discs will not be accepted, and should be accompanied by sufficient documentation to enable their implementation. Please enclose an SAE if you want your manuscript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

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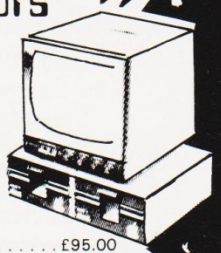

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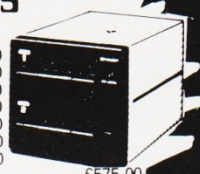

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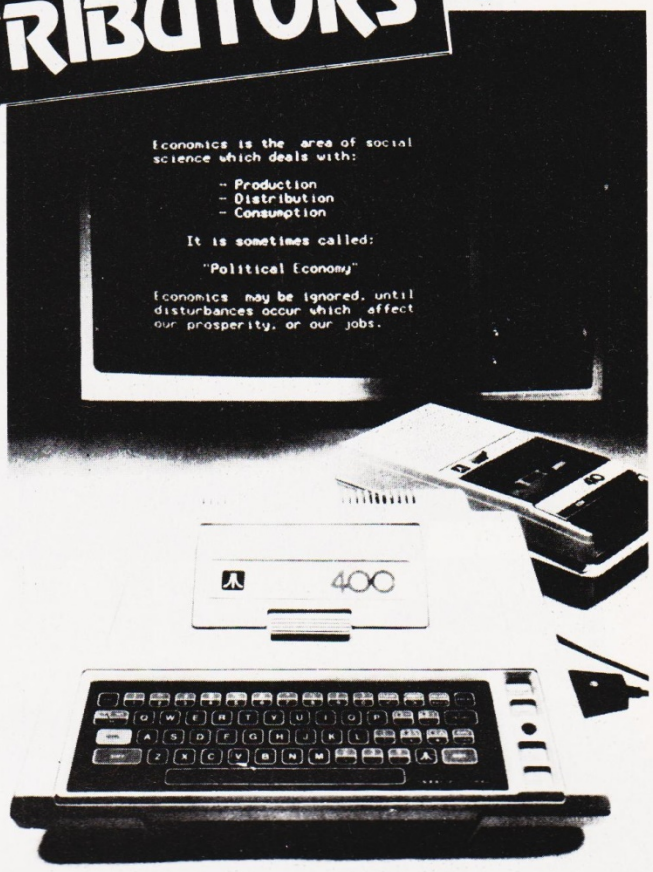

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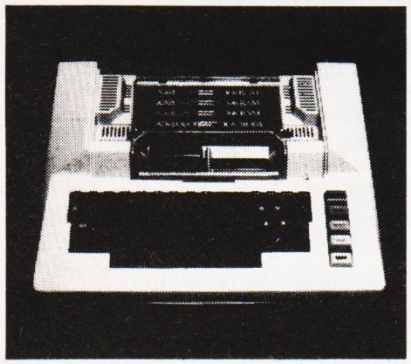

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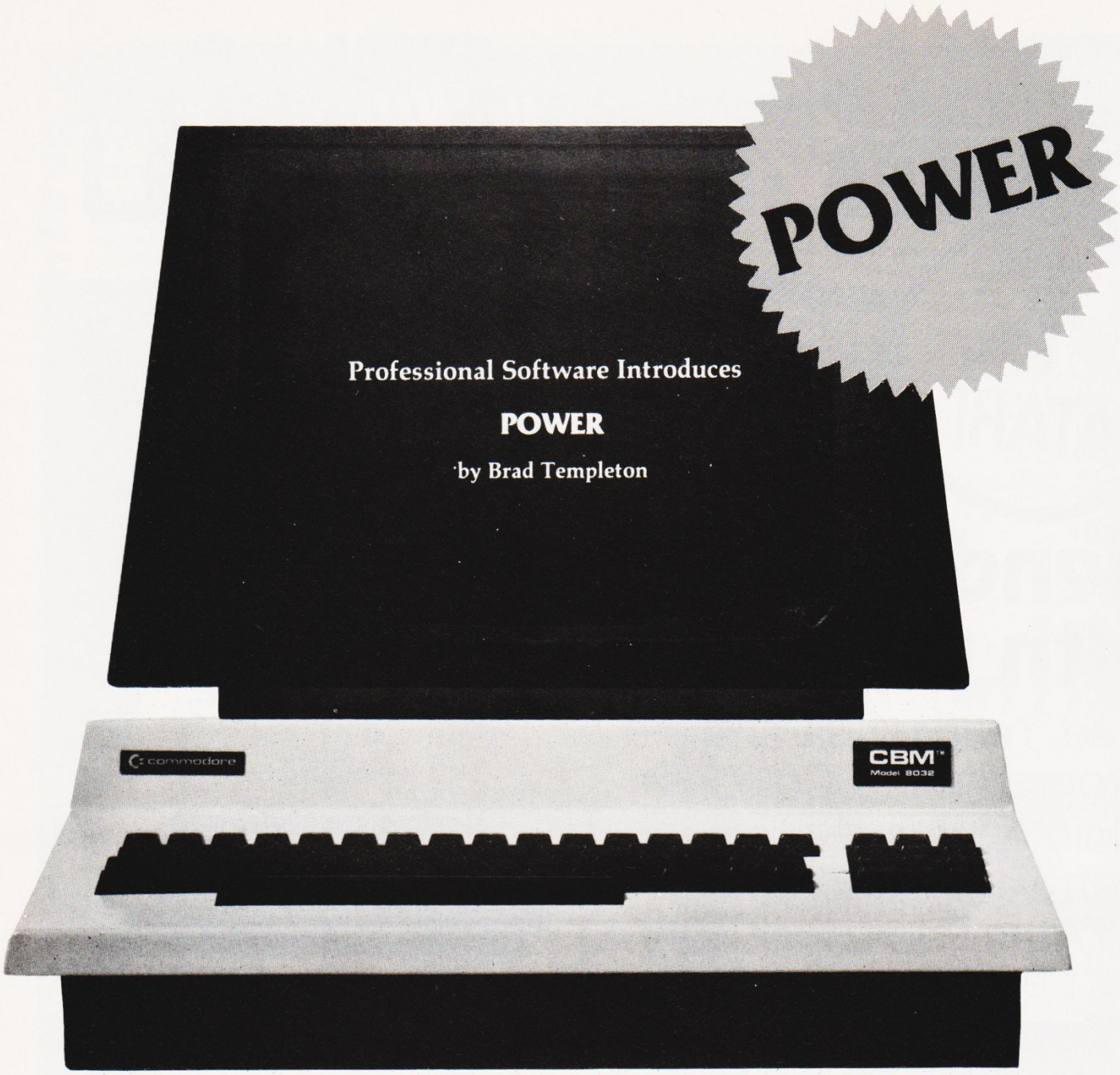

ADD POWER TO YOUR COMMODORE COMPUTER

£49

POWER produces a dramatic improvement in the ease of editing BASIC on Commodore's computers. POWER is a programmer's utility package (in a 4K ROM) that contains a series of new commands and utilities which are added to the Screen Editor and the BASIC Interpreter. Designed for the CBM BASIC user, POWER contains special editing, programming, and software debugging tools not found in any other microcomputer BASIC. POWER is easy to use and is sold complete with a full operator's manual written by Jim Butterfield.

POWER's special keyboard 'instant action' features and additional commands make up for, and go beyond the limitations of CBM BASIC. The added features include auto line numbering, tracing, single stepping through programs, line renumbering, and definition of keys as BASIC keywords. POWER even includes new "stick-on" keycap labels. The cursor movement keys are enhanced by the addition of auto-repeat and text searching functions are added to help ease program modification. Cursor UP and cursor DOWN produce **previous** and next lines of source code. COMPLETE BASIC program listings in memory can be displayed on the screen and scrolled in either direction. POWER is a must for every serious CBM user.

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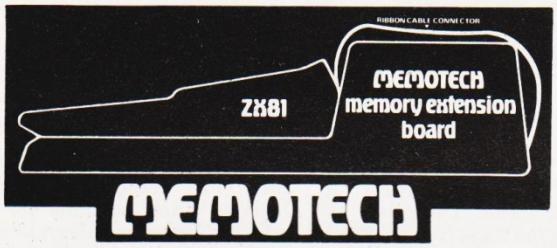
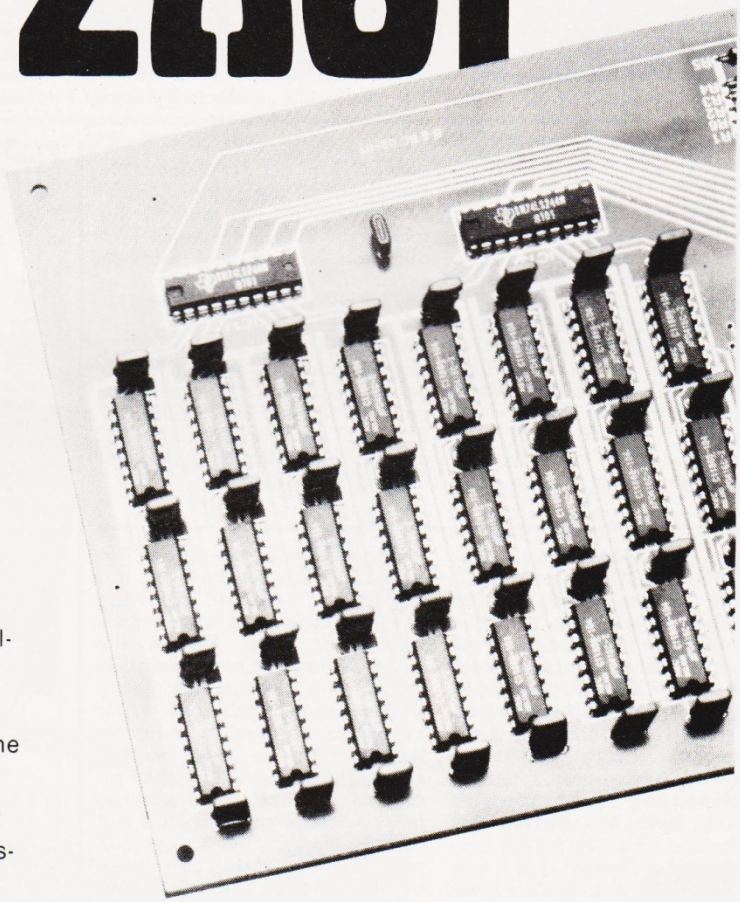
MEMOTECH

48K memory extension for the ZX81





The MEMOTECH memory extension board will allow the ZX81 to run 48K BASIC programs which may include up to 16K of assembly code.
The unit contains a genuine 48K of user transparent RAM, and accepts such BASIC commands as:
10 DIM A(9000).
A range of I/O Port boards and A/D, D/A convertors is available. The unit is compatible with the ZX Printer, and RS232 interface will be available soon.
The MEMOTECH memory has a fully buffered control-data-address bus with PCB 40 way header plug.
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Please make cheques payable to:

MEMOTECH

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



Photo by Grant Pedlar. Report by Tim Hartnell.

MICROFAIR SUCCESS

Over 4,000 people attended the first ZX MICROFAIR at Westminster Central Hall on September 26th. Organiser Mike Johnston said the response was far greater than he had expected. 'Many people had to wait in the rain for two hours or more to get in,' he said. 'I'd like to apologise to those people, but point out that because it was our first such venture, we had no idea it would be so successful.' Once people were inside the hall, they agreed the wait had been worthwhile. Over 30 different stands, featuring ZX81 peripherals, books and software, were on show, and all stand holders said interest was very high. 'We're planning our next ZX MICROFAIR sometime in March,' said Mike. 'It will be at the same location, but we'll hire double the floor space, so there should be no problems with long queues.' The National ZX80 and ZX81 Users' Club, which helped organise and publicise the ZX MICROFAIR, said club members have written to say how much they appreciated the show although some were a little upset about the wait!

SEE RIGHT THROUGH IT

Two new and interesting products have been introduced by Ian Dunkley's Datron Micro Centre in Sheffield. The first is a transparent lid for the Apple which replaces the existing snap-on one. Called Appleview it is intended for the school and college market. It also adds a certain interest to home based systems – you can see at a glance just what cards you've got plugged in on the bus. The second product is a lockable lid, again for the Apple. Actually it's your lid but they fit the lock! This seems an ideal product for the business market, especially where dongles are in use for software protection. The two offerings are £17.50 and £12 respectively, both are ex-VAT, and a combination of the two called Appleview Plus will run you £27.50 plus VAT. Information from the Datron Micro Centre, 2 Abbeydale Road, Sheffield S7 1FD.

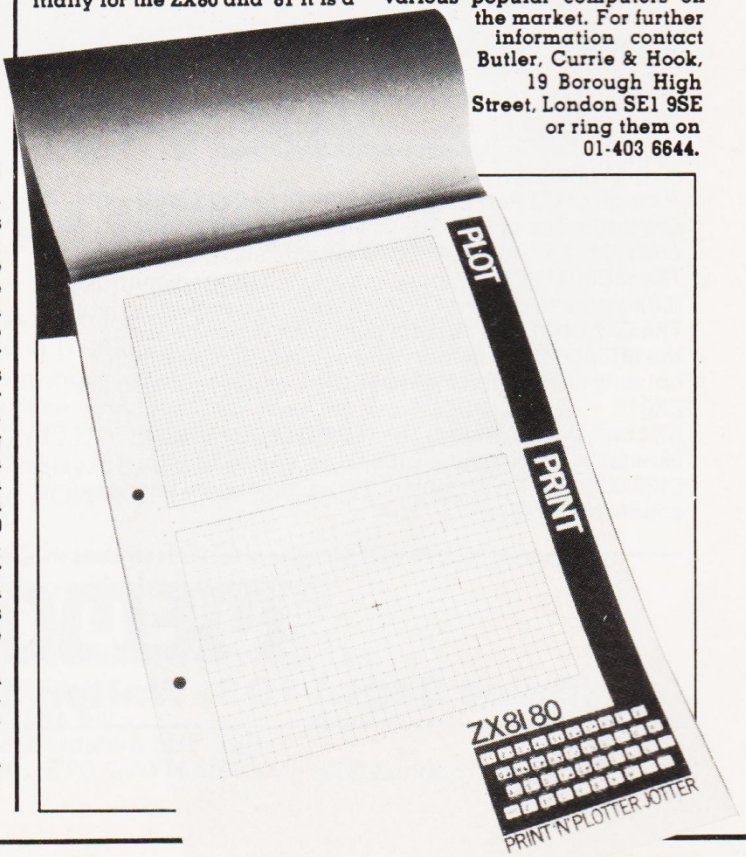
LEND AN EAR

As the International Year of Disabled People slowly fades into oblivion and one looks at just what has actually been done in the last 12 months to bring new technology devices into production on their behalf one might miss a rather neat little offering for deaf people. Developed by Kegwain with backing from the NRDC and assistance from the Royal National Institute for the Deaf, it is a portable terminal allowing the transmission of text over the telephone lines. Called the Deaf Communication Terminal (or DCT for short) it has a strip display and a full typewriter keyboard. The system indicates the state of the line, whether ringing or engaged and includes a number of interesting features. The conversation can be monitored by ear so a person with normal hearing can 'listen in', the unit can store up to 1000 characters internally with further cassette back-up, a printer can be added and the unit can send automatic distress calls as it is pre-programmed with the name and address of its user. The device costs £370 through the Breakthrough Trust and further information can be obtained from the manufacturers, Kegwain Ltd, at Unit 1, Threemilestone Industrial Estate, Truro, Cornwall TR4 9LD.



PLOTTING FOR SUCCESS

They say that the best ideas are simple ones and following in the footsteps of Flowchart System's stick-on, lift-off symbols we have the PRINT 'N' PLOTTER Jotter. Designed initially for the ZX80 and '81 it is a tear-off pad containing 100 preprinted sheets of the screen layout and plot positions of the computer. Also available in film, indeed if you order more than five pads they'll give you one, it costs £3.50 inclusive per pad. The company hopes to launch other versions for the various popular computers on the market. For further information contact Butler, Currie & Hook, 19 Borough High Street, London SE1 9SE or ring them on 01-403 6644.



CONSUMER NEWS

A CASE FOR PROTECTION

If you are worried about transporting small, delicate components or pieces of equipment then you might be interested to hear of the new range of aluminium cases from Imhof-Bedco. Starting price for the range is £22 and three sizes are available, all with carrying straps and foam inserts. For the executive minded among you there is a briefcase insert available too. For information on this range and Imhof's other products write to them at Ashley Road, Uxbridge, Middx UB8 2SQ.





TAPE STORAGE

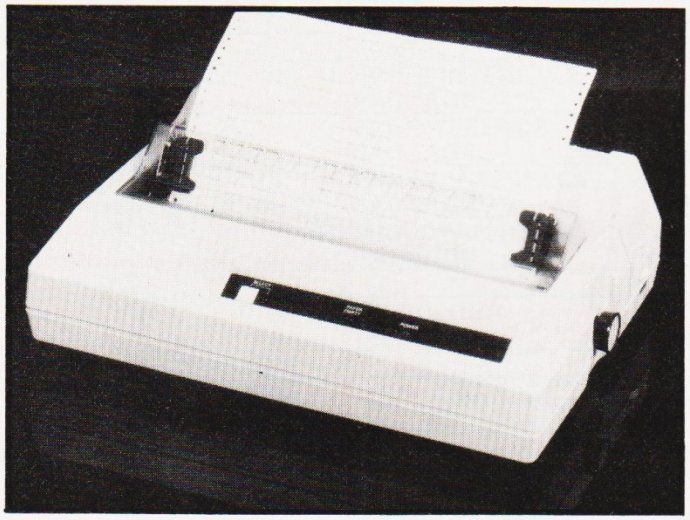
The Philips digital cassette drive is making another appearance in the micro market as the mechanism for Currah Computer Component's 220M mini digital recorder. Priced at £195 it offers a high volume, low cost method of data and program storage which is substantially quicker in operation than audio cassettes, 6000 baud, and can hold up to 128K per cassette. The system is fully software controlled and intelligent. Full details from Currah Computer Components at Unit 7, Sandgate Industrial Estate, Mainsforth Terrace, Hartlepool, Cleveland TS24 7AH.

ON COURSE

The first course on offer in this month's list is one you can take home with you. Designed by the National Computing Centre the package is intended to teach people with a small business computer to program simple applications in BASIC. The course is supplied on a 90-minute audio cassette with a workbook, quick reference card, and answer book, and costs £39.50 including VAT. The duration of the course is expected to be between 40 and 60 hours depending on the motivation of the student and it is assumed that the individual will have access to a computer system. For more information contact the NCC at Oxford Road, Manchester M1 7ED or visit your local NCC Micro Centre. Hull College of Higher Education are offering a range of courses on micros and word-processors. The only remaining micro course is a two-day event on the 3rd-4th December entitled Can Micros Work For You? and will cost £100. More information on this and the WP courses from the Micro Centre, Hull College of Higher Education, Cottingham Road, Hull HU6 7RT. Cocking and Drury are offering courses and seminars in APL, next dates are 1st-3rd December, 12th-14th and 26th-28th January for the basic course at £250, 16th-18th February for the advanced course, again at £250, and January 20th for a seminar on their new multi-user version of a data management package. For more details contact them at 16 Berkley Street, London W1X 5AE or ring on 01-491 6172. A course with a slight difference this time, it's really a permanent workshop. Run by CCS Micros they open in the evenings and a set of six sessions will cost £27.50 including a manual. The whole idea sounds very promising and you can get more info from CCS at 62 Tritton Road, London SE21 8DE or ring Philip Denyer on 01-670 4411. The Institution of Electrical Engineers are running a five-day course on Circuit Analysis by Computer at the Café Royal in London between 22nd and 26th February 1982. Information and application forms can be obtained from IEE (LSE), Savoy Place, London WC2R 0BL. And, last but by no means least we have two workshops organised by Mills and Allen Communications. The first is on December 2nd on Computer Based Training Techniques and Uses which is followed on the 3rd and 4th by a two-day course on CBT – A Practical Introduction to Design. Both are being run in conjunction with the Manpower Services Commission and information can be obtained from Sue Punch at Mills & Allen Communications, 1-4 Langley Court, Long Acre, London WC2E 9JY or ring her on 01-240 1307.

BASIC ADDITION

Just a couple of months ago we ran an article on how to extend one version of BASIC available on the NASCOM. Well, now you can buy a package that extends the BASIC supplied with that machine and gives you Double Precision Arithmetic. Developed by Mike York, a man who describes himself as a radical astrologer, theoretical physicist and a computer programmer, the Expander will cost around £5. If you buy the Double Precision package you get the Expander with it for about £15. All you have to do to add your own commands is to specify the Hex address of the routine that operates the command and do a USR call. A selection of commands are supplied as standard. The package requires the 8K BASIC ROM and NAS-SYS monitor. The four function Double Precision package offers 14 decimal places of accuracy and uses BASIC variables for storing the results. For more information on either package send Mike York an SAE at 9 Rosehill Road, London SW18.



CAT COMES HOME

It's escaped again! Once more released into an unsuspecting world is the latest Heathkit catalogue packed with electronics and computing kits. Among those of immediate interest to computerists are the new H-25 printer which offers 9 by 9 matrix printing, some new software packages and a 624-page computer directory. For your copy write to Heath Electronics UK Ltd, Bristol Road, Gloucester GL2 6EE or call in to their London shop in Tottenham Court Road, W1.

LUCK OF THE DRAW

Those of you with good memories may remember a competition from the beginning of the year which was run by Centronics. Open to anyone who bought a Model 737 printer between mid-May and mid-July the first and second prizes were presented last week by David Fairbairn of the NCC at a Press conference in London last week. Also on show for the first time in the UK was a new 132 column version of the successful Model 150 which goes under the title of Model 152. Prices of the new model will start under £700 and it is intended to be a direct competitor to some of the newer Japanese imports from OKI and Epson. As a guide to the value for money offered by the new generation of matrix printers the performance of today's models is greater than that of the first ever matrix printer launched 10 years ago (the Model 101) at a fifth of the price. Information on the unit from your local stockist or direct from Centronics at Petersham House, Harrington Road, London SW7.

TRS & GENIE SOFTWARE

TRS80 16k LII;

MOONBASE RESCUE £9.95

On the third moon of the giant plant loja there is a group of Astronauts stranded, their L.E.M. destroyed by a sudden shower of meteorites. The call comes from Federation HQ for help, before the meteors become too concentrated to penetrate. YOU are the only L.E.M. jockey in parsecs — it is up to you to decend through the ever increasing showers, to land on one of the few flat areas and then steer your way back up and dock with the mother ship in orbit.

A fast machine-code arcade style game, that gets progressively more difficult.

TOWER OF TALOS £8.95

Dare you enter the Tower of Talos and his minions. In this graphic quest into the tower, you can define the number of rooms (from 10 to 25) to search. You must avoid the deadly grasp of Talos the Brass, which will vapourise you. You must also avoid the walls as Talos pursues you, as they are instantly fatal, and to make things a little more difficult there are a few traps and pitfalls sprinkled around, but these are usually not too fatal! If you are killed, you may be revived, but the wandering wizard will set you a task.

DEATH DREADNAUGHT £9.95

In the far reaches of space you come across a derelict ship. On entering the airlock you find signs of death and destruction everywhere. Turning, you find the airlock refuses to open. Your only chance of escape lies in the shuttle craft. But you will have to avoid the creature that still lurks in this carnel house of a ship.

It is possible to escape, and to prove it we have the sequel.

DOMES OF KILGARI £12.95

At long last the sequel to the infamous Death Dreadnaught is here. All the tension that made Dreadnaught a smash hit is DOUBLED in The Domes of Kilgari. DEATHTRAPS to please the most daring soul. PUZZLES and MAZES beyond your ability to solve. And the ever lingering feeling that you ARE NOT ALONE. So get set to enter Interspacial Digitron's Ion Generating Station and prepare for the ADVENTURE of a lifetime under The Domes of Kilgari. — You may make it to civilisation yet . . .

TEMPLE OF THE SUN £12.95

You have discovered the ruins of the long lost Temple of the Sun. Within its depths are clues to the ancient Rites of the Shaman. The find of the century awaits, if, you can penetrate the many deathfall traps set by the ancients. So come now, if you dare on an adventure into the mysterious depths of the TEMPLE OF THE SUN and emerge with wealth and power. Or die in the attempt.

GAUNTLET OF DEATH £12.95

As Thoran the Barbarian, you must traverse the perils of the gauntlet. It is filled with invisible traps, avoidable by the experienced and the lucky.

Use the arrow keys to move about the rooms. The white lines are walls and the D's are doorways.

In your travels, you'll come upon potions marked with P's. Some potions help heal you, some can poison you, and others allow you to see the traps. Pressing U will show you a list of potions in your possession, and allow you to drink onw. But, don't drink a potion immediately upon finding one. The ability to see traps lasts only briefly, and healing potions don't help when you aren't hurt.

Scattered through the rooms are treasures marked by T's. They will help you survive the rigors of your travels.

Pressing I will give you an inventory of your possessions and injuries.

During your travels, you will see numbers chiseled into the walls. These *may* be significant.



Christmas Offer !!! — 10% OFF

to save postage and Rudolf's hooves — Santa is offering 10% off, to anyone buying two or more programs — Offer expires December 24th midnight.

All prices include V.A.T. & Postage.

ACCESS ORDERS TAKEN BY PHONE

ALGRAY

Algray House, 33 Bradbury Street, Barnsley,
South Yorkshire Telephone (0226) 83199

Video Genie

13K ROM version available

16K £275 + VAT



- ★ Latest version with vu-meter & extra keys
- ★ 16K RAM, 12K Microsoft Basic
- ★ Includes software, manuals and leads
- ★ All our machines are fitted with lower case characters as standard
- ★ 32K Ram memory version of Video Genie £329 + VAT

£329 + VAT 32K RAM

Optional Extras

- The unique 1K 'BIONIC' Rom £29.50 + VAT
- Sound unit £15 + VAT
- Double joysticks with software £28 + VAT
- Lower case characters with '£' sign. £20 + VAT

We stock a wide range of Genie accessories for the businessman and the hobbyist, Word processing, stock control, ledgers systems plus games. Refer to catalogue

BIONIC ROM

The Rom enhancement for your Video Genie will add the following immediately accessible features to your machine:

- Lower case driver
- Keyboard debounce
- Shift lock
- Repeat key routine
- Screen printout
- Cursor select
- Keyboard lock
- Bleeping keyboard

etc.

Available only from us. Kit £25 + VAT fitting £4.50

SAVE!



EPSON MX-80

Letter quality matrix printer, has full software control of 40, 88, 66 or 132 columns 80cps bidirectional, disposable print head. There's lots of printers to choose from, but once you have compared you will find it hard to pass up to the MX-80. £ call

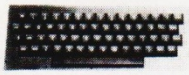
Video Genie interface £35 + VAT
Other interfaces available.

ATARI®

400 & 800 Computer Systems

ATARI 400 £295 + vat
ATARI 800 £543 + vat

ACORN ATOM



8K ROM, 2K RAM BUILT £149
12K ROM, 12K RAM BUILT £229
Power supply £10.20
Colour moduator £23 all plus vat

Available shortly
- The BBC Microsoft basic upgrade
- 'Plug in' disc drive unit

Phone for availability of **VIC 20** *Computer*

Q-Tek Systems Ltd.
2 Daltry Close Old Town
Stevenage Herts
Tel: (0438) 65385

Send £1 for latest catalogue (refundable). Please add vat to all items. Orders under £50 add 60p p + p otherwise carriage at cost

Special Offer To COMPUTING TODAY Readers



£149.95 + Post & Packing + VAT

NEW MICRO TANTEL TALKS TO YOUR COMPUTER

New Tantel is probably the most exciting development in microcomputer communications of the decade. For the first time, it is possible to connect a home computer directly to the Post Office Prestel system with full control of the hardware – at a reasonable price.

New Tantel is a Prestel adaptor in its own right. Connect it to a Post Office jack 96A and the aerial socket of your TV and it's ready to use. But the real flexibility begins to show when you interface to your computer. Not only do you have access to 190,000 pages of information, but you can use new Tantel as a COLOUR GRAPHICS terminal for your computer using the PRESTEL STANDARD character set of 40 characters by 24 lines, and you can define the colour of each symbol individually, with or without flashing. Scrolling is software selectable as is a cursor.

New Tantel talks to your computer at 1300 Baud CUTS standard interface. You can of course use your computer's ASCII Keyboard to send messages or letters through New Tantel to the Prestel computer, thus extending the facilities of the Tantel unit.

HOW TO ORDER YOUR TANTEL
By Phone – Access or Barclaycard holders can call 01-455 8208
By Post – Please use the coupon below. You can pay by cheque, postal order, Access or Barclaycard.
Please allow up to 28 days for delivery. There is a seven day money-back option of course, and the product is fully guaranteed for one year.

MICROLINK

59 The vale, London NW11 8SE.
Telephone 01-455 8208

QUANTITY	ITEM	ITEM PRICE	TOTAL
		Inc Post & Packing & VAT	
	TANTEL	@ £175.43	
	APPLE INTERFACE PACKAGE	@ £24.95	
	PET INTERFACE PACKAGE	TBA	
	TANDY INTERFACE PACKAGE	TBA	
	MICROTAN INTERFACE PACKAGE	@ £19.98	
	14" COLOUR TELEVISION	@ £215.00	

To: Microlink, 59 The Vale, London NW11 8SE. I enclose cheque/postal order for £_____. Please debit my Access/Barclaycard No.

Signature .....

Name (please print) .....

Address .....

.....

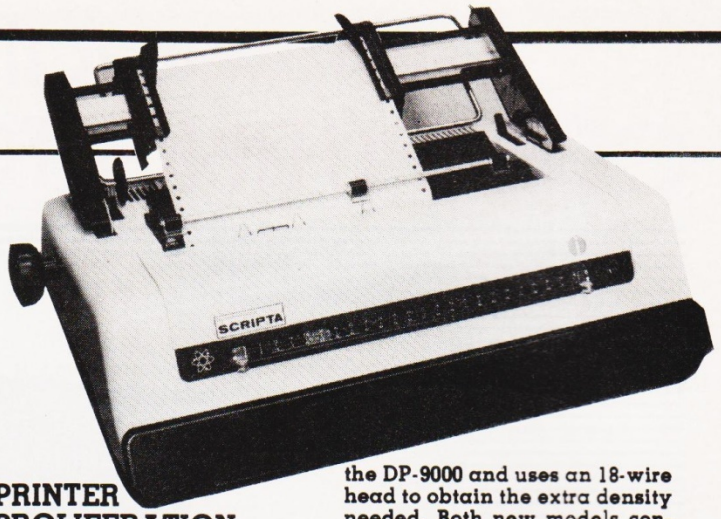
Telephone No. .....

Prestel is the trademark of British Telecom's viewdata service.

CENTRING ON THE SOUTH

The first independently owned and run Micro Centre in the South of England was opened on September 29th by David Faribairn, director of the NCC. Operated by Bridgewick Services Ltd it is sited at 12 Christchurch Road, Bournemouth and intends to provide a permanent demonstration site for businessmen as well as offering advice and running courses. A varied range of products ranging from microcomputers to peripherals are on show and BSL also intend to offer software development, training and a bureau service. For more information drop in to see them between 9 am and 5 pm any weekday or write to the above address. The young lady in the picture is, as far as I can recall, not Mr Fairbairn!



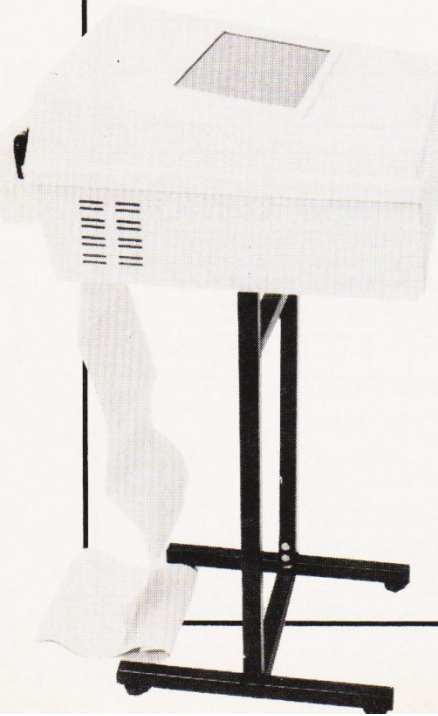


PRINTER PROLIFERATION

You could probably bet money on it as it always seems to happen. Every time we do an update of one of the Buyer's Guides the following week's post is full of new models that we would have liked to include. Last month we updated the printer section of the Guide and, naturally enough, this month we've got another batch! Dataplus are distributing the RO version of Olympia's Scripta daisywheel printer with a Centronics compatible interface. One-off prices start at £836 plus VAT with optional tractor feed and sheet feed mechanisms available. More details from Dataplus at 39-49 Roman Road, Cheltenham, Gloucestershire GL51 8QQ. Anadex are taking advantage of the Compec show to launch two new variants of their existing range. The DP-9620 is a 200 cps enhancement of the DP-9500 and is available in RO or KSR formats, the latter having a single line display. The second model is the WP-6000 and this is a correspondence quality version of the DP-9000 and uses an 18-wire head to obtain the extra density needed. Both new models contain all the existing functions of their parents and more information can be obtained from Anadex at the show or write to them at Weaver House, Station Road, Hook, Basingstoke, Hants RG27 9JY or ring on 025-672 3401. Dataproducts are introducing a Centronics compatible daisywheel printer called the D-50C. Capable of printing at 47 cps bi-directionally it will be available with uni- or bi-directional tractors and a single sheet feeder. End user prices are not available at the time of publication but it is likely to be around £1,500. More information from Dataproducts at Index House, Ascot, Berkshire SL5 7EU. And, finally, Brospa Data are offering two enhanced models based on the Olivetti DY311. Designated the DY211, a low cost version for the micro market and the DY811 which is a high speed version. Prices are £836 and £1,822 respectively with quantity discounts available. More details from Brospa at 87 Castle Street, Reading, Berks RG1 7ST or ring on 0734 589393.

HUSHING IT UP

Two new products in the ever-widening market of add-ons could not exactly be described as 'blowing their own trumpets'. In fact their function is to keep the noise down as much as possible. The first product is designed for small printers and is claimed to keep the noise levels down to 55 dBA at 1 M distance. Fitted with a transparent window and a cooling fan it is made out of high impact ABS and there is an optional stand. Further details on this one from General Acoustics at PO Box 20, Scarborough, North Yorks YO11 1DE. The second is from our old friends, Power Equipment, who are offering an acoustic enclosure for the Qume Sprint series of printers. The product is a variant of the one that keeps the devilish noisemaker, Diablo (...get it?) attached to our word processor under control. Once again it comes with a cooling fan and the whole of the front panel lifts up to allow easy access to the printer. One suggestion though: could you please make the fixings on the two detachable rear entry slots work from the inside? It is exceedingly awkward to clamber over and one feels so undignified! For information on this and the rest of their range drop Power Equipment a line at Kingsbury Works, Kingsbury Road, London NW9 8UU.





TAKING IT WITH YOU

Portable data terminals seem to be all the rage nowadays but this one is a little different. Instead of being the normal hand-held type this is a fully portable VDU fitted into a 10½" by 5" by 14" case. The Gercom Micropro 1 is being distributed by ISG Data Sales for around £950 in one-off quantities. Display format is 16 lines of 32 characters with a full ASCII keyboard that folds up to protect the screen during transit. Interfacing is via the usual RS232 and 20 mA with baud rates between 1100 and 9600. Other features include page and scroll modes, XY cursor control, line editing and a printer port. More information from ISG Data Sales, Unit 9, Fairacres Industrial Estate, Dedworth Road, Windsor, Berks.

BUSINESS NEWS

MAILBOX GOES LIVE

The end of September saw the start of Prestel's Mailbox service, at last! Based on the Croydon 'Enterprise' computer (no it doesn't have an engineer called Scotty), the service can be accessed by users with full alpha or just numeric keypads provided their terminal is registered on that system. Two sorts of message frame are available, free format for those with alpha keyboards and formatted for those with numerics.

A directory of those users on the system is available on Prestel although you may remain 'ex-directory' if you wish. When PANDA goes live in 1983 the system will be available on all regional centres (it is currently limited to just the London and South East). Charges for the use of Mailbox will be 5p per frame from January 1982 but at the moment it's FREE! More information on the service can be obtained by looking at the appropriate Prestel pages.





WIDENING HORIZONS

Comart, the main UK distributor for North Star equipment, have announced the introduction of a new desktop model called the Advantage. Based on the ubiquitous Z80A with 64K of RAM and a pair of 5¼" discs, the system joins the growing ranks of complete systems in a box. Complete, in fact, with a business graphics package and compatible with both CP/M and Graphics DOS, an upmarket version of the North Star DOS. Unusually for North Star the system is not S100 based but it has the facility for having up to five extra boards plugged in. The system prices start at £2,500 and it will be available through Comart's distributors and the Byte Shop chain. For more information contact Comart at PO Box 2, St Neots, Cambs or ring on 0480-215005.



BRITISH WORDS

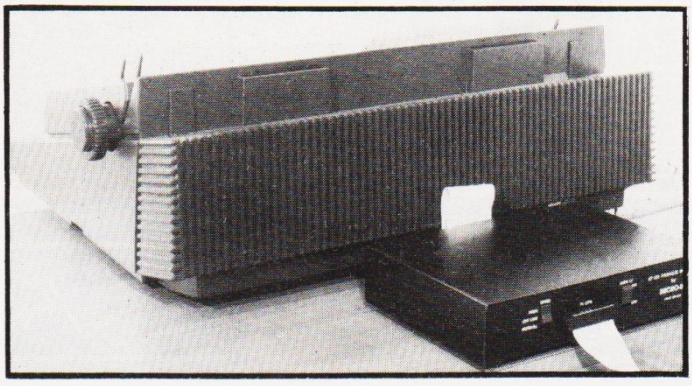
The Caltext Word Processor recently introduced by Computer Ancillaries of Egham is being distributed by R H Symonds of 640 Great Cambridge Road, Enfield, Middx. Based on the LSI Computers M-Three, the system that seems to get into everything, it can also be used under CP/M as a small business system. A basic set of hardware will cost £2,895 and this rises to just under £4,000 with software and printer installed. In the WP mode some 2,600 A4 pages of text can be held on the integral discs although this amount depends on the model selected. Three printers are available depending on the user's requirements and the whole system is also available for leasing. More information from Carol Lewis at the above address or ring her on 01-366 4211.

HANGING IT TOGETHER

The Australians seem to be rapidly becoming a force to be reckoned with in the world of micro innovations. First they bring us the ice-cold tube of lager to quench our parched brain cells, then they come up with the man behind Interface, and now they've produced the interface. Seriously though, this product was designed and produced in Australia and interfaces an Olivetti ET121 Electronic Typewriter to any of the TRS range, the Video Genie, Exidy's Sorcerer and the Apple. Each kit is supplied with a year's warranty and service and the device still leaves the Olivetti free to act as a normal typewriter. For prices and information write to Frank Cody Electronics at Star House, Gresham Road, Staines, Middx TW18 2AN or ring on Staines 62682.

SUN GET DEALERSHIP

Sun Computing Services of Feltham have been officially appointed as dealers for London and the Home Counties by Ai Computers. They will be supplying the complete range of hardware and software, that's the ABC 24 and 26 desktop computers, together with the new Winchester drive. For information on the products and a full list of the dealers contact Ai Microcomputers at Unit 10, Weirvale Industrial Estate, Denham Way, Maple Cross, Rickmansworth, Herts WD2 2RU.

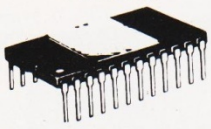


GETTING IT GRAPHICALLY

Hewlett Packard have introduced a new variant of their graphics terminal range called the HP2623A. Designed for both business and technical use it comes in at the bottom of their price range at £2,479 and offers 512 by 390 dot resolution. The terminal is supported under HP's business graphics software packages and also under the technical Graphics/1000-II. It'll also run under Tektronix's Plot 10 software. A number of options are available including an integral thermal printer for hard copy at £800, a line drawing character set at £69 and various national keyboard options at £69 each. For more details contact HP's Computer Systems Group at King Street Lane, Winnersh, Wokingham, Berks.

COMPUTER SYSTEMS

NEW LOW PRICES



Micros, memory and support

MC1489	85	74S262	9.95
MC1488	85	74S287	2.50
MC14411	11.95	74S288	2.50
MC14412	11.95	74S471	4.95
1702	6.95	74S472	11.95
2101	2.99	74S474	11.95
2102	99	8T26	1.80
2111	2.32	8T28	1.80
2112	2.32	8T95	1.80
2114L	1.30	8T97	1.80
2142	10.40	8T98	1.80
2376	11.50	SC/MP2	9.95
2513	6.50	8080	5.49
2516(5v)	2.95	8085	11.95
2532	7.95	8086	65.00
2708	2.40	8154	11.50
4027	2.95	8155	12.50
4116	1.95	81LS95	1.30
4118	4.95	81LS96	1.30
5204	7.95	81LS97	1.30
57109	12.43	81LS98	1.30
57161	9.95	8212	2.45
6011	4.95	8216	2.50
6116	10.50	8224	2.50
6402	4.95	8228	4.20
6502	7.95	8251	4.95
6520	4.50	8253	10.95
6522	7.95	8255	4.95
6532	8.50	8257	10.95
6545	17.50	8259	11.95
6576	14.95	8678	12.95
6800	7.95	8602	2.20
6802	12.49	96364	10.95
6809	19.95	Z80-2mHz	7.50
6810	3.95	Z80-PIO	6.95
6821	4.50	Z80-CTC	6.95
6845	19.50	Z80-4mHz	8.95
6850	3.95	Z80-PIO	7.50
6852	5.95	Z80-CTC	7.50
74S00	59	Z8000	120.00
74S04	65	ADC0817	14.47
74S201	3.95	DG300	3.60
74S188	2.50	F8	9.95
		F8SMI	9.95

SOFTWARE

CP/M DISK WITH / MAN MANUAL



Available on 8" IBM format & 5¼ for TUSCAN & TRITON

TCL SOFTWARE

TCL Disc Basic	£55/£9
TCL Pascal	£120/£9

MICROSOFT

Basic-80	£155/£15
Basic Compiler	£195/£15
Fortran-80	£205/£17
Cobol-80	£325/£15
Edit 80	£45/£10
Macro 80	£75/£10

MICROPRO

Word Star	£255/£15
Word-Star/Mail-Merge	£315/£15
Data Star	£195/£25
Word-Master	£75/£15

DIGITAL RESEARCH

CP/M 2-2	£95/£18
MAC	£55/£10
SID	£45/£10

OTHERS

GENERAL DATABASE	£100/£5
SUPER SORT I	£125/£15
C BASIC 2	£75/£10
Z80 Dev Pack	£50/£12
ZSID	£60/£7

MEDIA (DYSAN)

5¼ S/Sided D/D	£4.20
,,per 10	£37.00
8" S/Sided D/D	£4.90
,, per 10	£43.00
C12 Data Cassettes	50p

MAIL ORDER

TEL & MAIL ORDERS ACCEPTED

BARCLAYCARD VISA

TUSCAN S100

A Z80 based S100 Computer



All Tuscans have built-in expansion interface, full RS232 serial I/O. Spare parallel output port (Centronics) IEEE 8BIT S100 expansion. Powerful Z80 processor and are expandable to full CP/M system.

DESIGNED & BUILT IN BRITAIN

16K Tuscan starter kit (inc. P.S.U. & keybd)	£299
16K Home Computer assembled & cased	£499
24K single drive CP/M system (assembled)	£999
60K twin drive CP/M business system	£1449

Also available with double sided drives for 8" and 5¼" systems. The Tuscan builds to meet all requirements, 5 spare S100 slots for your plug in boards. Full details on the Tuscan and peripherals is given in our new computer systems catalogue – also see our Software catalogue.

AND SPARES

74LS00

LS00	13	LS164	115
LS01	13	LS165	185
LS02	16	LS166	175
LS03	16	LS168	210
LS04	20	LS169	210
LS05	23	LS170	285
LS08	23	LS173	105
LS09	23	LS174	147
LS10	20	LS175	110
LS11	32	LS181	295
LS12	32	LS190	120
LS13	40	LS191	120
LS14	75	LS192	125
LS15	40	LS193	125
LS20	24	LS194	125
LS21	32	LS195	125
LS22	40	LS196	120
LS26	48	LS202	345
LS27	45	LS221	120
LS28	48	LS240	225
LS30	24	LS241	225
LS32	30	LS242	232
LS33	38	LS243	232
LS37	38	LS244	225
LS38	38	LS245	360
LS40	28	LS247	135
LS42	80	LS248	135
LS47	85	LS249	135
LS48	120	LS251	130
LS49	120	LS253	130
LS51	25	LS257	115
LS54	30	LS258	120
LS55	70	LS259	160
LS63	180	LS261	460
LS73	40	LS266	75
LS74	40	LS273	180
LS75	48	LS275	320
LS76	48	LS279	88
LS78	45	LS280	260
LS83	105	LS283	190
LS85	105	LS290	130
LS86	45	LS293	130
LS90	80	LS295	215
LS91	125	LS298	215
LS93	75	LS299	420
LS95	115	LS324	200
LS96	180	LS325	320
LS107	45	LS326	330
LS109	75	LS327	315
LS112	80	LS352	185
LS113	65	LS353	185
LS114	48	LS355	85
LS122	70	LS366	85
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LS139	80	LS386	85
LS145	120	LS390	140
LS148	175	LS393	140
LS151	85	LS395	210
LS153	85	LS396	198
LS155	85	LS398	275
LS156	85	LS399	230
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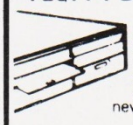

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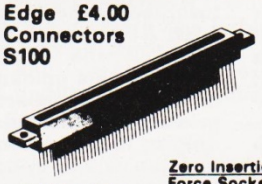

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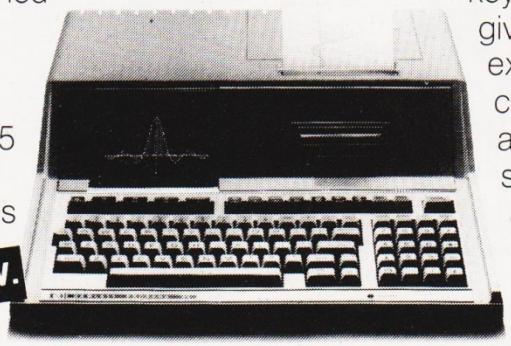

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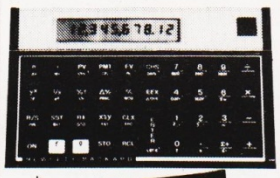

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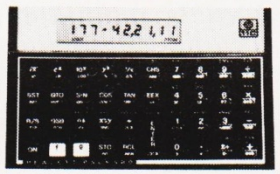

HP12C NEW

Featuring many of the facilities of the HP11C, the HP12C is a financial calculator designed to calculate compound interest, amortization, discounted cash flow, net present value and IRR, bond yield and price, annuities, odd days interest and statistics.

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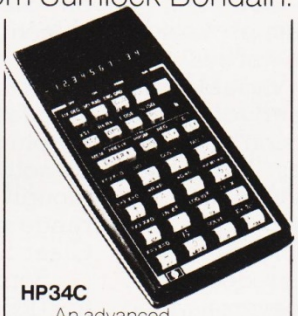

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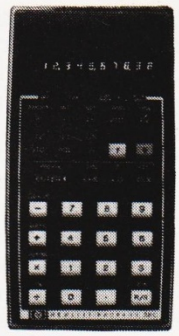

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Don Thomasson

Adding a direct screen copy facility to the Sorcerer/MX80 combination

Not so very long ago, in the September issue of CT to be precise, I wrote a short article called 'Getting Into Print'. In this I stated that it was not possible to transfer the contents of the Sorcerer screen onto the MX80 printer. As statements of this kind seem to have a habit of turning on one I was not surprised, some few days before the article appeared, to find that there is, indeed, a method of getting the Sorcerer to print its screen onto the MX80!

So, in an attempt to put things right, here is the necessary information and a short routine so that you can all benefit from the discovery.

Inside The Epson

The Epson MX80 printer employs a pair of microprocessors to control its actions, an 8049 and an 8041. The program for the 8049 is quite large, extending to 6K, and the behaviour of the printer can be varied extensively by using different programs.

The original program provided a number of type styles, vertical and horizontal tabulation, variable line pitch, and a number of other facilities. A later version dropped some of these facilities, but added 'Bit Mode', of which more anon. The most recent version seen at the time of writing covers most of the features offered by either of its predecessors, plus italic type and reverse video types. Since none of these programs appear to have identifying references, it is necessary to be specific when enquiring about them.

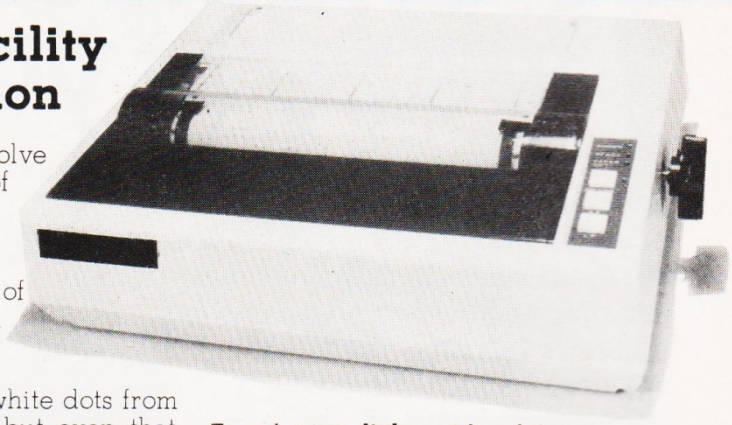
It should be added that some of the programs are available in three-ROM form, and to use these it is necessary to cut a link on the main circuit board to disable the program held in the 8049 microprocessor. Others are supplied as a 4K ROM and a specially programmed 8049. A little confusing, till you get the main idea.

Bit Mode

The most interesting facility offered by these programs is 'Bit Mode', which allows every dot position in the whole printout area to be defined as black and white. The only snag is that this can involve quite a lot of dots, up to about 7,400 per square inch. An A4 page could accommodate 650,000 dots, and storing that would involve more than 80K bytes of storage!

For some types of work, such as graph plotting, the amount of data can be cut down by specifying the position of black dots and counting off the white dots from the left hand margin, but even that can involve some complex programming.

For those who find themselves frustrated by their inability to make adequate use of Bit Mode, Screenprint may provide an answer.



Epson's trusty little matrix printer contains enough processing power to be able to cope with various type styles, tabulations and line pitches. It also copes with dot resolution graphics and some examples can be seen on the right.

Screenprint

Screenprint is a machine code program for the Z80, and though described here for the Sorcerer it can be adapted quite easily for other computers with memory mapped displays.

The Sorcerer stores its screen data in 1,920 bytes of RAM, each byte relating to a given character position on the 30-line by 64-character screen. Each byte holds an ASCII code, which is translated into a pattern of 64 dots by reference to the standard character RAM or the graphics RAM. The latter can be set by software to any desired pattern, though the lower half of the graphics range is reset to standard forms when Clear Screen is called.

Screenprint begins by setting IX to F080, the start of screen RAM, this being the screen pointer. An output sequence 1B,41,08 is then sent to the printer, to set up a line spacing of 8/72". Some, but not all, MX80 programs require this to be followed by the sequence 1B,32 to confirm the setting.

Bit Mode with 512 characters per line is then set by the sequence 1B,4C,00,02. This has to be done afresh for every line.

HL is now set to F800, the start of the character definition area, and the first character is read into A. The result is multiplied by eight and added to HL to form a pointer, each character definition occupying eight bytes.

The next operation involves storing the eight bytes defining the character, after which the first bit of each of the eight bytes is assembled in A to form the first data output to the printer. This process is necessary because the bytes define eight horizontal dots, whereas the printer requires eight vertical dots.

When A has been set, a NOP byte is provided: changing this to 2F reverses the print action to white on black, like the screen image, but black on white is clearer.

The byte is then output, and the program loops to J4 to assemble the next output byte. When eight bytes have been transferred, a jump is made to J2 to obtain the next character.

When the line is complete, IX AND 3F = 0, this being used to induce a jump back to J1 to start a fresh line, unless IX has reached F800, one location beyond the end of screen RAM.

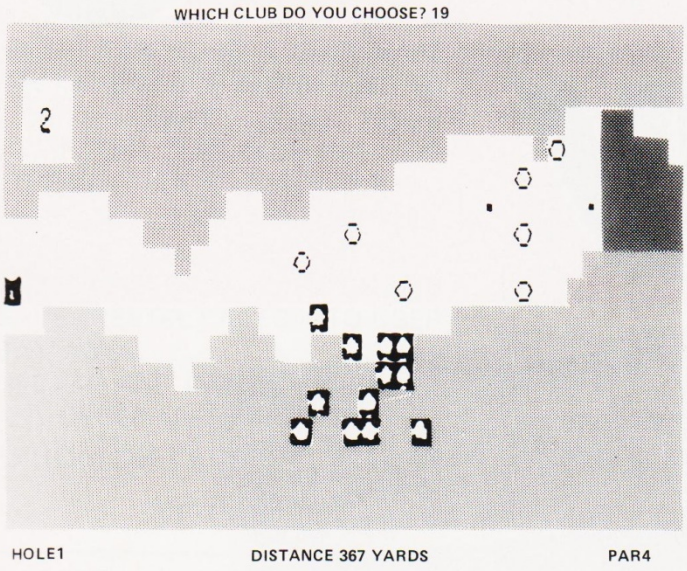
Finally, a sequence 1B,41,9 is output to restore the line spacing to the normal 1/6th inch pitch. Here again, some programs may require the sequence 1B,32 to confirm the new setting.

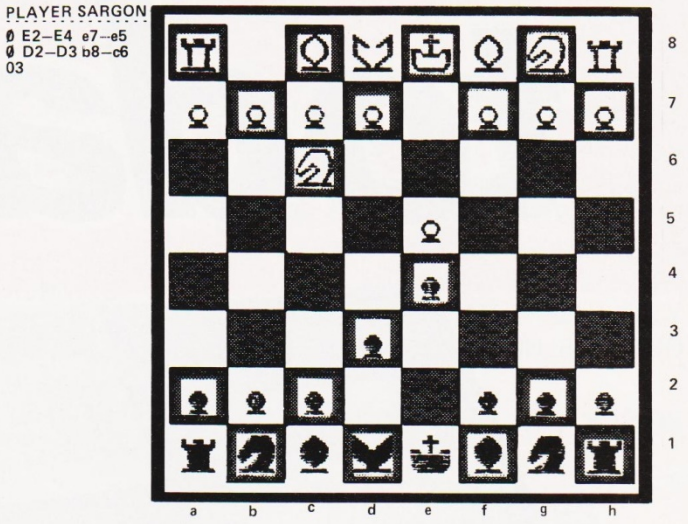
Performance

The time taken to print a screen is about one minute. The print quality produced is good. There is a slight discrepancy between the vertical width of a line and the nearest vertical spacing, but this is not too obvious.

An important consideration is that a manual call to Screenprint will show up on the screen and thus on the printed copy, so it is usually wise to arrange for an automatic call at an appropriate point in the program which creates the display. If this is not possible, then the intruding text can be covered by using cursor left to regain the start of the line, spacing forward to erase the text, and then pressing Return. The Monitor does not object, and ignores the redundant part of the input.

SCREENPRINT





Two sample printouts of graphics produced on the Sorcerer taken directly from the printer. Because some reduction of size has had to be performed in order to get them onto the page the individual dots have tended to close up but you can still see the difference in tones available. These are produced by putting less dots into a given area.

Program Listing

```
                PARLOT EQU 0E021    ;PARLOT
0008 C5          SCRPR PUSH BC      ;must be used
0009 D5                PUSH DE      ;because all
000A E5                PUSH HL      ;eight bits
000B F5                PUSH AF      ;must be
000C DD E5             PUSH IX      ;outputs
000E DD 21 80 F0       LD IX,0F080
0012 3E 1B             LD A,27      ;ESC
0014 CD 21 E0          CALL PARLOT
0017 3E 41             LD A,65      ;A
0019 CD 21 E0          CALL PARLOT
001C 3E 08             LD A,8
001E CD 21 E0          CALL PARLOT
0021 3E 1B             LD A,27      ;ESC
0023 CD 21 E0          CALL PARLOT
0026 3E 32             LD A,50      ;2
0028 CD 21 E0          CALL PARLOT
002B 3E 1B         J1  LD A,27      ;ESC
002D CD 21 E0          CALL PARLOT
0030 3E 4C             LD A,76      ;L
0032 CD 21 E0          CALL PARLOT
0035 AF                XOR A
0036 CD 21 E0          CALL PARLOT
0039 3E 02             LD A,2
003B CD 21 E0          CALL PARLOT
003E 21 00 F8      J2  LD HL,0F800
0041 DD 7E 00          LD A,(IX)
0044 DD 23             INC IX
0046 5F                LD E,A
0047 16 00             LD D,0
0049 CB 13             RL E
004B CB 12             RL D
004D CB 13             RL E
004F CB 12             RL D
0051 CB 13             RL E
0053 CB 12             RL D
0055 19                ADD HL,DE
0056 06 08             LD B,8
0058 11 00 00          LD DE,0
005B 7E            J3  LD A,(HL)
005C 12                LD (DE),A
005D 23                INC HL
005E 13                INC DE
005F 10 FA             DJNZ J3-$
0061 06 08             LD B,8
0063 21 00 00      J4  LD HL,0
0066 C5                PUSH BC
0067 06 08             LD B,8
0069 CB 16         J5  RL (HL)
006B 17                RL A
006C 23                INC HL
006D 10 FA             DJNZ J5-$
006F 00                NOP             ;To allow for
0070 CD 21 E0          CALL PARLOT     ;inversion
0073 C1                POP BC
0074 10 ED             DJNZ J4-$
0076 DD E5             PUSH IX
0078 E1                POP HL
0079 7D                LD A,L
007A E6 3F             AND 63
007C 20 C0             JR NZ,J2-$
007E 3E 0D             LD A,13      ;CR
0080 CD 21 E0          CALL PARLOT
0083 3E 0A             LD A,10      ;LF
0085 CD 21 E0          CALL PARLOT
0088 7C                LD A,H
0089 FE F8             CP 248
008B 20 9E             JR NZ,J1-$
008D 3E 1B             LD A,27
008F CD 21 E0          CALL PARLOT
0092 3E 41             LD A,65
0094 CD 21 E0          CALL PARLOT
0097 3E 09             LD A,9
0099 CD 21 E0          CALL PARLOT
009C 3E 1B             LD A,27
009E CD 21 E0          CALL PARLOT
00A1 3E 32             LD A,50
00A3 CD 21 E0          CALL PARLOT
00A6 DD E1             POP IX
00A8 F1                POP AF
00A9 E1                POP HL
00AA D1                POP DE
00AB C1                POP BC
00AC C9                RET
```

computing today

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If you've ever wished that you could add the commands you wanted to the language you use then you should consider using FORTH. This exceedingly versatile language is slowly gaining in popularity simply because of its versatility and adaptability. For the next four months we are running a series on programming in FORTH so if you want to be one step ahead of the crowd make sure of your copy next month.

LOGICAL ADVENTURES

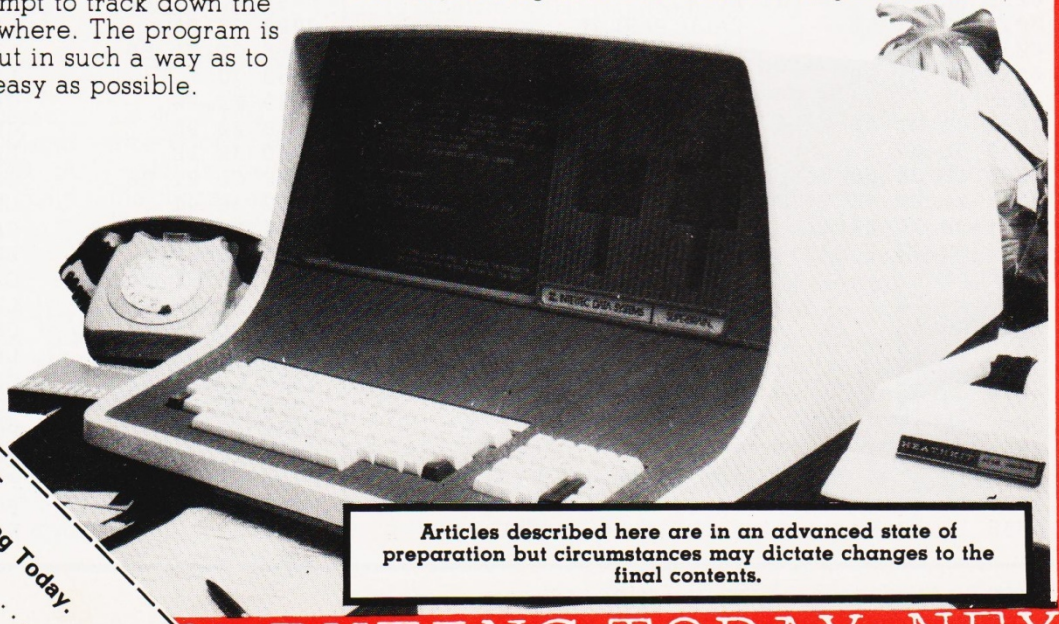
If you think that fantasy games are all random forays through someone else's program then you need The White Barrows. Designed around a completely logical framework of chambers with fixed rules of play it provides you with a chance to use more strategic methods in your attempt to track down the sorcerer who's in there somewhere. The program is written in ATOM BASIC but in such a way as to make its conversion as easy as possible.

PROGRAMMING FOR THE HANDHELD REVOLUTION

It may still be a two-horse race in the portable computer stakes but the next few months may well bring some fresh runners onto the scene. We take a look at the various ways that you can get just a little bit more performance out of the PC1211 and its close relatives. The techniques apply equally to the other small systems.

HOW SUPER IS THE BRAIN?

Once again we return to one of the systems that we have reviewed over the past three years and take a second look — our equivalent of the 20,000 mile road test. This month we revisit the Superbrain, one of the first desktop systems to hit the market, and see what a long-term user thinks of its performance.



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NASCOM MEMORY DISPLAY

G P Roberts

Screen more information for program checking

It is sometimes useful, and often instructive, to examine selected portions of memory. This can be done using the M or T commands under NAS-SYS to give the hexadecimal representation, while the decimal equivalent can be accessed using the BASIC PEEK or DEEK statements.

The following program expands these facilities and enables any portion of available memory to be scanned at a chosen rate. Both the address and contents of each memory location are displayed simultaneously in their binary, hexadecimal and decimal forms. Additionally, where possible, the character representation of the contents of memory is shown. These characters are also presented as a continuous string moving progressively across the screen from right to left.

Hex Chex!

Machine code routines can be checked for correct loading using the program and their string content is clearly visible. There is an obvious teaching application for the program in introductory microcomputer courses where it should assist students to grasp how program instructions and data are organised in memory.

The program is written for a NASCOM 2 with the optional graphics chip which allows maximum character representation. To avoid the disruptive effect of printing certain screen control characters, the program replaces them by spaces. Their numerical representation remains unaffected however. Adaptation of the program to other machines should not prove too difficult provided they have similar screen formatting facilities. NASCOM 2 owners without the additional graphics should omit the lines referring to 'SET' statements.

Program Listing

```
10    DIM H$(15):Z$=" ":Q$=CHR$(21)
20    Z=0:U=1:T=2:F=4:G=8
30    H=16:J=256:K=65536
40    FOR X=Z TO 15:READ H$(X):NEXT
50    FOR X=U TO G:READ C(X):NEXT:CLS
60    GOSUB 480:GOSUB 530
70    GOSUB 600:GOSUB 480
80    REM**READ MEMORY
90    FOR AD=S TO E:BY=PEEK(AD)
100   REM**CONVERT TO BINARY
110   A=AD:P=K:A$=Z$
120   FOR X=U TO H:P=P/T
130   IF A<P THEN A$=A$+H$(Z):GOTO 150
140   A$=A$+H$(U):A=A-P
150   NEXT
160   B=BY:P=J:B$=Z$
170   FOR Z=U TO G:P=P/T
180   IF B<P THEN B$=B$+H$(Z):GOTO 200
190   B$=B$+H$(U):B=B-P
200   NEXT
210   REM**CONVERT TO HEXADECIMAL
220   A=AD:AH$=Z$:FOR X=U TO F:I=INT(A/H)
230   AH$=H$(A-H*I)+AH$:A=I:NEXT
245   B=BY:I=INT(B/H):BH$=H$(I)+H$(B-I*H)
250   REM**PRINT DATA
260   SCREEN 30,3:PRINT A$
270   SCREEN 30,4:PRINT AH$
280   SCREEN 29,5:PRINT AD
290   SCREEN 30,7:PRINT B$
300   SCREEN 30,8:PRINT BH$
310   SCREEN 30,9:PRINT "[2 SPC]"
320   SCREEN 29,9:PRINT BY
330   IF BY <28 THEN GOSUB 430
340   SCREEN 30,10:PRINT "[SPC]"
350   SCREEN 30,10:PRINT CHR$(BY)
360   SCREEN 3,14:PRINT Q$
370   SCREEN 46,14:PRINT CHR$(BY)
380   FOR X=U TO R*J:NEXT X:NEXT AD
390   SCREEN 6,12:PRINT" END OF DISPLAY-"
400   SCREEN 25,12:INPUT"ANOTHER DISPLAY";R$
410   IF R$="YES" THEN CLS:GOTO 60
420   CLS:END
430   REM**SUPPRESS CONTROL CHARACTERS
440   FOR X=U TO G
450   IF BY = C(X) THEN BY=32:GOTO 470
460   NEXT
470   RETURN
480   REM**CENTRE TITLE
490   T$="NASCOM MEMORY DISPLAY"
500   L=LEN(T$):W=3041-L/T:FOR X=U TO L
510   POKE W+X,ASC(MID$(TS,X,1))
520   NEXT:RETURN
530   REM**REQUEST DATA
540   SCREEN 4,3:INPUT "Start of Memory";S
550   SCREEN 4,5:INPUT "End of Memory";E
560   SCREEN 4,7:PRINT "Speed of Display";
570   INPUT"((Fast) 0 to 9 (Slow))";R
580   IF R<>INT(R)OR R<0 OR R>9 THEN 560
590   CLS:RETURN
600   REM**FORMAT SCREEN
610   FOR X=3 TO 92:SET(X,45):SET(X,46)
620   SET(X,4):SET(X,16):SET(X,31)
630   SET(X,36):SET(X,44):NEXT:FOR X=4 TO 31
640   SET(3,X):SET(92,X):NEXT
650   SCREEN 4,3:PRINT"Memory [11 SPC] Binary"
660   SCREEN 4,4:PRINT"ADDRESS [5 SPC] Hexadecimal"
670   SCREEN 4,5:PRINT" [16 SPC] Decimal"
680   SCREEN4,7:PRINT"Memory [16 SPC] Binary"
690   SCREEN 4,8:PRINT"CONTENTS [4 SPC] Hexadecimal"
700   SCREEN 4,9:PRINT"[16 SPC] Decimal"
710   SCREEN 4,10:PRINT" [14 SPC] Character"
720   SCREEN 4,1:PRINT" From"S
730   SCREEN 38,1:PRINT"to"E:RETURN
740   DATA 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F,
750   DATA 8,12,13,20,21,22,24,17
```

CROSS HATCHER

K Davies

Use the DAI's colour graphics to set up your colour TV

This program may prove of practical use to television engineers like myself. It is written for the DAI Personal Computer and is fairly self-explanatory.

The CHR$(12) in line 10 clears the screen and line 12 generates a 400 Hz test tone from one of the three internal oscillators.

There are four test options; a straight crosshatch (300-400), a large circle (200-240), a colour bar pattern (500-600) and a raster scan in primary colours (700-760).

The graphics commands are only transferrable to a system with equally high resolution colour graphics.

Program Listing

```
10  PRINT CHR$(12):CURSOR 14,23:PRINT "COLOUR
    TELEVISION TEST PROGRAM"
12  SOUND 0 1 15 0 FREQ(400.0)
15  PRINT:PRINT
16  PRINT "CROSS HATCH PATTERN[3 SPC]TYPE A"
20  PRINT:PRINT
21  PRINT "PICTURE GEOMETRY[6 SPC]TYPE C"
30  PRINT:PRINT
31  PRINT "COLOUR BARS[10 SPC]TYPE C"
40  PRINT:PRINT
41  PRINT "PURITY[15 SPC]TYPE D"
50  PRINT:PRINT:PRINT:PRINT
51  PRINT "To return from any subroutine press SPACE bar"
60  P=GETC
61  IF P=65.0 THEN 300
62  IF P=66.0 THEN 100
63  IF P=67.0 THEN 500
64  IF P=68.0 THEN 700
65  GOTO 60
100 MODE 6
200 FOR X=0.0 TO PI*2.0 STEP 5E-2
210 DOT 170+80*COS(X*2.0),130+80*SIN(X*2.0) 15
220 NEXT X
230 DRAW XMAX/2.0 XMAX/2, YMAX 15
240 DRAW 0,YMAX/2 XMAX, YMAX/2 15
250 GOSUB 2000
300 MODE 5
310 A=XMAX:B=YMAX:C=20.0:D=0.0
320 DRAW C,D C,B 15
330 C=C+20.0
340 IF C > =335.0 THEN C=20.0:GOTO 360
350 GOTO 320
360 DRAW D,C A,C 15
370 C=C+20.0
380 IF C > =255.0 THEN 400
390 GOTO 360
400 GOSUB 2000
500 MODE 5
510 FILL 0,0 40,YMAX 15
520 FILL 40,0 85,YMAX 12
530 FILL 85,0 125,YMAX 14
540 FILL 125,0 170,YMAX 5
550 FILL 170,0 215,YMAX 2
560 FILL 215,0 260,YMAX 3
570 FILL 260,0 305,YMAX 1
580 FILL 305,0 XMAX,YMAX 0
600 GOSUB 2000
700 MODE 5:A=1.0
710 FILL 0,0 XMAX,YMAX A
720 P=GETC
730 IF P=32.0 THEN 750
740 GOTO 720
750 A=A+2.0:IF A > 5.0 THEN GOSUB 2000
760 GOTO 710
2000 P=GETC:IF P=0.0 THEN 2000
2001 IF P=32.0 THEN MODE 0:GOTO 10
2002 GOTO 2000
```

ATOMIC PARTICLES

M Freebury

Two simple routines for the ATOM give you a text editor and a simple front 'panel'

Texted IV allows the setting up of a single 'paged' file of text. Each page is one screenful. When RUN, the editor sends you into 'create file' which allows writing to the screen. Pressing 'escape' followed by a number from 1 to 5 causes the following menu to be executed:

1) LOAD a new page from cassette
2) SAVE this page on cassette
3) Clear screen, enter edit mode (create file)
4) Enter edit mode (alter file)
5) End.

On LOAD and SAVE, pressing 'return' after the number sets the corresponding process in motion.

Program Listing

```
100  DIM WW(2), P(-1)
110  *NOMON
130  [
140  :WW1 JSR #FFE3
150  STA #80
160  RTS
170  :WW2 JSR #FFF4
180  :WW0 JSR #FFE3
190  CMP @27
200  BEQ WW1
210  CMP @13
220  BNE WW2
230  JSR #FFED
240  JMP WW0
250  ]
260  P.$6
270a LINK WW0
280b O=?#80-48
290  O=290+(O*20)
300  G.O
310  *LOAD"SCRN"
320  G.a
330  *SAVE"SCRN" 8000 8200
340  G.a
350  P.$12
360  P.$30
370  LINK WW0
380  G.b
390  E.
```

This program helps with direct access to machine code. A section of 15 locations with their contents are shown, and the following options are available:

MXXXX	-	move to memory location xxxx (Hex)
JXXXX	-	execute from memory location xxxx (Hex)
I	-	move on to location contained in next two bytes (for absolute jumps)
RETURN	-	move on one location
'–'	-	move back one location
xx	-	insert xx (Hex) into current location pointed to.

The current location pointed to by the program is shown with '*' either side of the address. All numbers must be Hex and the length given, so M0100 is acceptable, but M100 is not, FF (return) is acceptable, but C (return) is not.

Program Listing

```
100   @=12;DIMZ(5);N=1000;P.$@
110a  P.$30;?#E1=0;F.I=N-7TON+7
120   IF I > 4095@=14
130   IF I < 4096@=11;P.0;@=0;
      IF I < 256P.0;IF I < 16P.0
140   P.&I;@=12;C=?I
150   IF C < 16@=11;P.0;@=0;P.&C';
      @=12;G.f
160   P.&C';@=12
170f  N. ;?#80E9=42;?#80EE=42;P.$11
180d  IN.$Z;O=CH$Z
190   IF O=73 N=N?1+(N?2*256);G.a
200   IF O=77 GOS. c;G.a
210   IF O=45 N=N-1;G.a
220   IF O=13 N=N+1;G.a
230   IF O=74 GOS.c;LINK N;G.a
240   Z?4=Z?1;Z?3=?Z;F. I=0 TO 2;Z?
      I=0;N. ;GOS.c;?R=N; N=N+1;G.a
250c  T=4096;N=0;F. I=1 TO 4
260   C=Z?I;C=C-48;IF C > 9 C=C-7
270   N=N+T*C;T=T/16;N.;R.
```

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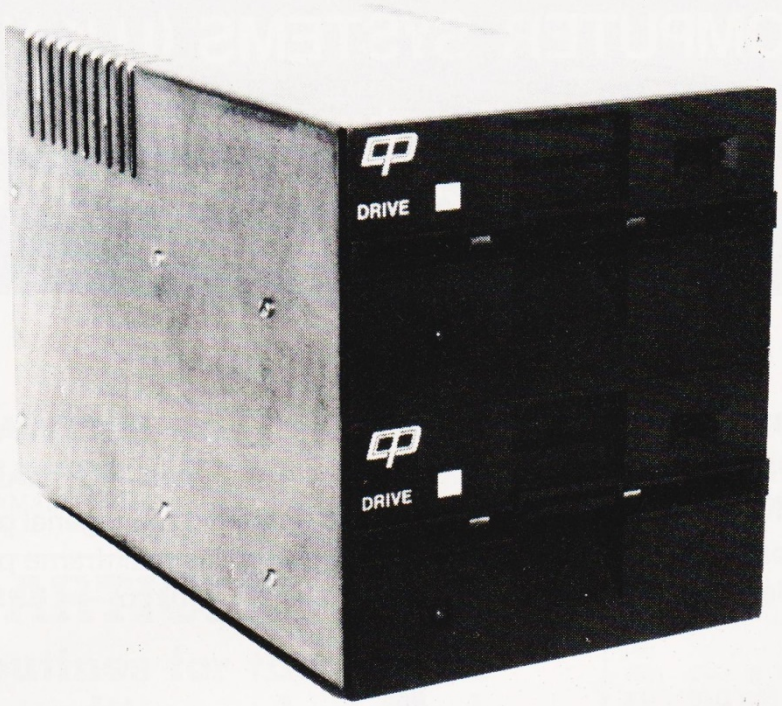

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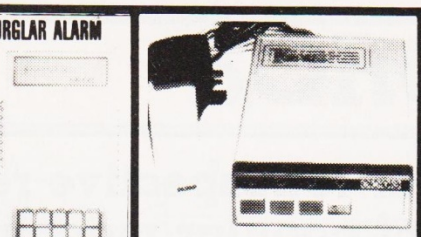

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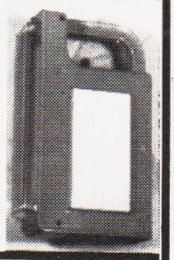

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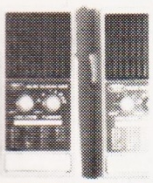

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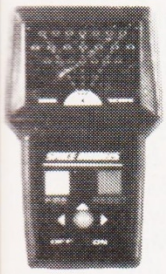

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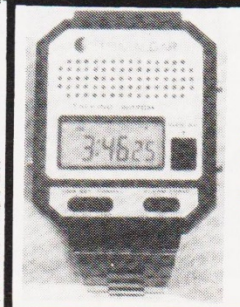

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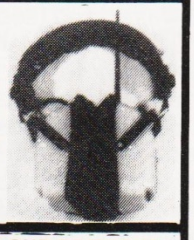

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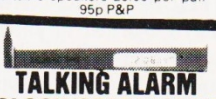

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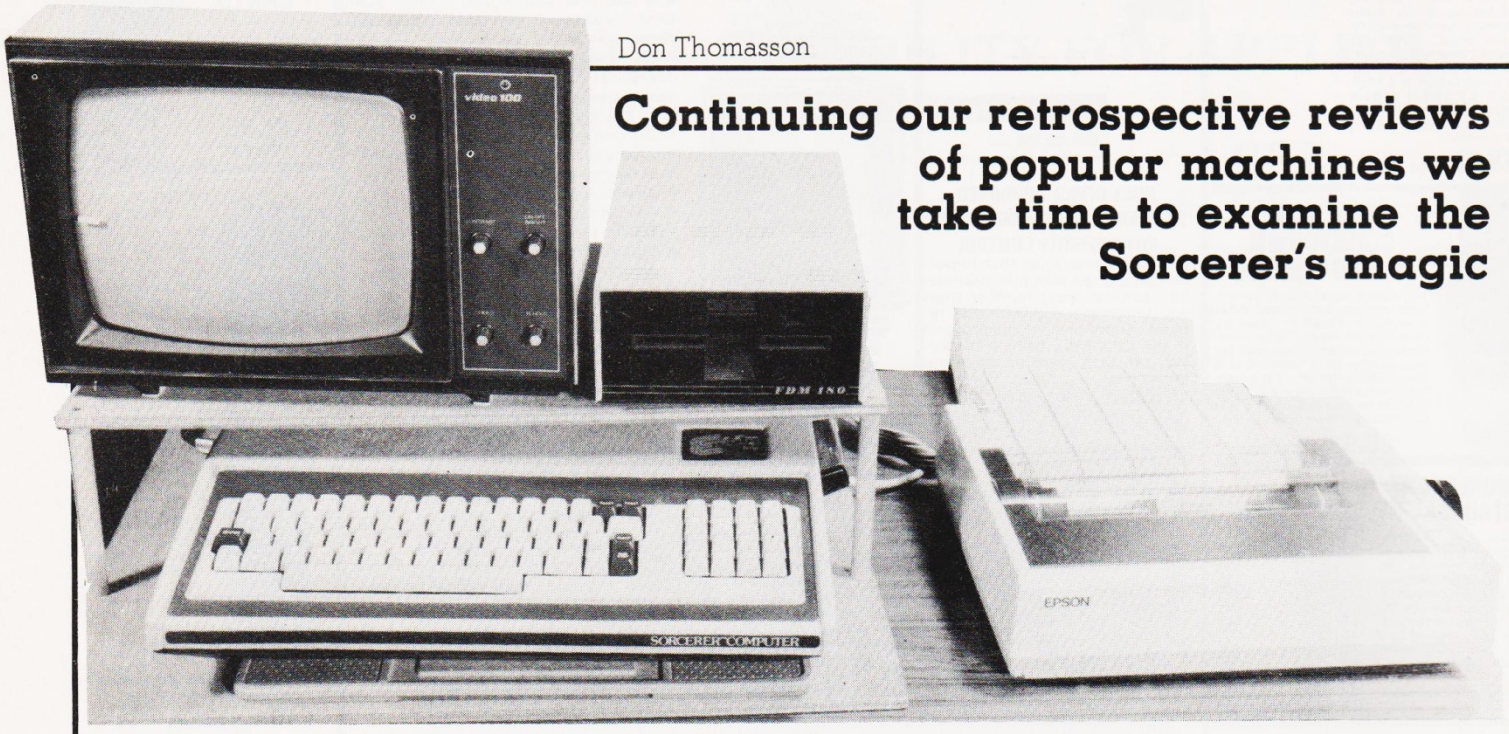
Don Thomasson

Continuing our retrospective reviews of popular machines we take time to examine the Sorcerer's magic



The Exidy Sorcerer is not one of the best known micro-computers, which is a pity, because it is a far better machine than some that have become household names. To be frank, I had never heard of the Sorcerer until, in mid-1980, my two sons began to talk of buying one. All three of us are professionaly involved with computers, but we felt the need to have our own private facilities with which we could experiment more freely.

In the end, we bought two Sorcerers between us, one for each household. Initially, we confined ourselves to cassette based systems with dedicated video monitors. Before long a printer became essential, so an MX80 was added (see Getting Into Print, CT, September 1981). More recently a single disc drive has appeared, and we also have a variety of experimental devices such as music generators and joysticks, some homebuilt. These are for occasional use, the main use of the computer centring round the word processing facility (which was used to produce the draft of this article) and the machine code development system.

After a few months we began to meet other Sorcerer users, and this has led to a useful exchange of ideas and information, mainly through the London Sorcerer Club, which meets from time to time at the Willesden College of Technology (Voluntary Secretary is Nick Merton, 406a Kenton Road, Harrow) and the European Sorcerer Club (ESCape), run by Colin Morle, 32 Watchyard Lane, Formby, near Liverpool.

Because we enjoy finding answers to operating questions, we have learned a great deal about the Sorcerer hardware and software, and in general we like what we have found.

So let us consider what a Sorcerer is and what is does.

The Hardware

There are plenty of single-board-under-the-keyboard micros about now, but the Sorcerer was one of the first. It was also one of the first to use a Z80 processor, now seen as a desirable feature for serious work, especially if CP/M is to be used. The separate video monitor is a convenience, because it can be positioned to suit the user, a special advantage to those whose eyesight is beginning to lack youthful sparkle.

The Z80 can talk to up to 64K of store, and in the 48K Sorcerer this capability is fully used. Above the 48K of RAM an 8K block is reserved for a plug-in ROMPAC (T), which can take various forms, including 'home-brewed' programs. Then comes the 4K monitor, and then the 4K devoted to screen display.

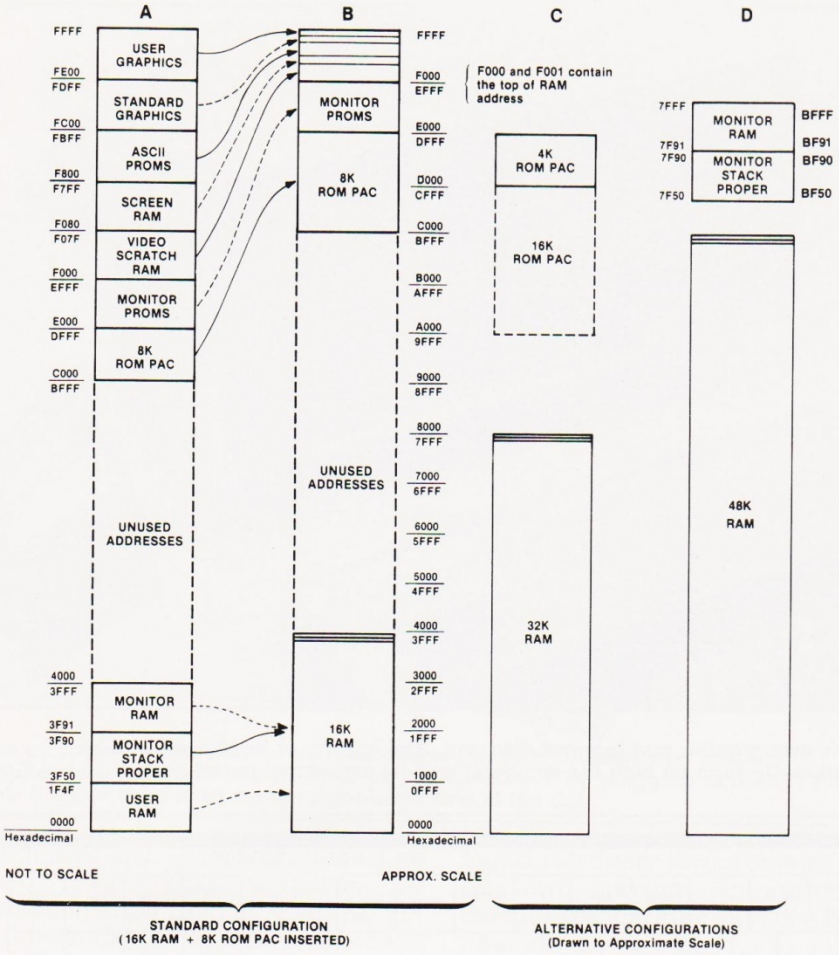
The Sorcerer can be operated with less than 48K of RAM, and in that case relocation of the Monitor scratchpad at the top of available RAM is automatic, but the extra memory is so inexpensive that the full 48K is now the usual standard. An extension to 56K is possible if the ROMPAC is not in use. At one time, we thought that we would never make full use of 48K, but it seems no more than adequate with discs in use. By the time CP/M and MBASIC are loaded, we have no more than 17K to play with. That's enough, but by no means excessive.

The video system is a special feature of the Sorcerer. First, the keyboard is capable of generating all 256 ASCII codes, using a Graphics Shift key to call codes in the upper half of the range. The graphics produced by these codes are user-definable on an 8x8 dot matrix, but the graphics for codes in the 128-191 range are reset to standard graphics at switch-on and whenever Clear Screen is called via the Monitor. Coupled with a 30-line display and 64 characters per line, this allows very complex visual patterns to be created.

The basic Sorcerer also includes twin cassette interfaces with motor control, a serial interface, a parallel interface with two alternative operating modes, and a 50-way interface carrying address and data lines plus control signals. This last provides for direct connection of an S100 expansion box and/or up to four disc drives. An adequate power supply completes the equipment.

So far, with an average duty cycle of several hours per day and occasional all-night sessions, our only failure has been a dynamic memory chip which lost one bit. We cured this by replacing the chip, having traced the offender with the Test routine included in the Monitor.

The Sorcerer is thus a comprehensive piece of equipment. It is not built like a battleship, the case being made of plastic mouldings, but the internal



Memory map configurations for the various RAM options available on the Sorcerer.

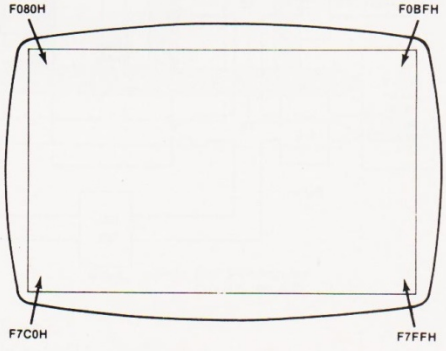
engineering is sound, and after a year of hard use a clean-up to remove nicotine stains left the equipment looking as good as new.

Incidentally, our Sorcerers are of the Mk II variety, and as far as we know no significant design changes have been found necessary since the Mk II replaced the Mk I, which had a very similar specification but was limited to 32K of RAM.

The Firmware

The Monitor is fairly orthodox, providing vectored send and receive routines for input and output; load, save, and dump, with direct entry to RAM when required; and a comprehensive video controller with scrolling and cursor control. The ingenious keyboard routine allows the keyboard itself to be of ultimate simplicity, yet provides for up to six different codings for each of the character keys, according to the state of the shift keys.

There is also the Test routine, which checks RAM and both sets of processor registers. There are routines for setting up the I/O vectors and working parameters, and the drivers for the various interfaces. Some of the the working parameters are worth mentioning: a delay can be set to slow down display speed over a wide range. The prompt character can be altered. Go addresses can be set when saving programs, for auto-start. File types can be set at will. Tape baud rate can be set to 300 or 1200, the high speed working well if cheap 'certified' cassettes are avoided. We have found that TDK C46 cassettes, cut down to length as appropriate, give us more reliable



A quick Graphic Detail, the four corners of the screen and their corresponding memory addresses.

results than anything else, and cost less in the long run.

Finally, a group of routines deal with the Batch control system, which allows processing sequences to be controlled by tape instruction. Since we have few regular procedure routines, we have made little use of this, but in some applications it could be invaluable.

The Standard BASIC ROMPAC is written in 8080/5 code, but executes faster on the Z80. The standard Microsoft repertoire is used, and the main routines are identical with those on other Z80-based machines, except that their location in store is changed and the Monitor links are different. Being an interpreter, the program is not expected to be fast, but it is adequate for most purposes, and those in a hurry should use machine code.

The Development PAC caters for this. Written in full Z80 code, it provides editing, assembly, linking and debugging facilities for Z80 machine code programs. Using it demands some care and patience, but with a little practice it can be tamed and made to do a useful job.

The Word Processor ROMPAC is surprisingly effective. It has some imperfections, such as an occasional failure to keep up with very fast typing, and not all the functions described in the literature are operative with all printers, but we find it entirely practical, now that we have gained a proper understanding of its characteristics.

The Software

When we were considering whether to buy a Sorcerer, we were warned that there would be no software for it. That was no deterrent, as we intended to write our own, but we have since found that the statement was only partly true. There is an ample supply of Sorcerer software, if you know where to look, though perhaps less than is available for some other machines. The flow of professional software is augmented by a regular supply of offerings from other users, some of very high quality. A quick check through the card index of our taped routines shows a total of 105, though this includes programs under development.

Some of the most interesting programs are add-ons for the ROMPACs, extending their facilities and making them easier to use. The 'Bradford' Toolkit adds a number of valuable functions to the BASIC ROMPAC, such as on-screen

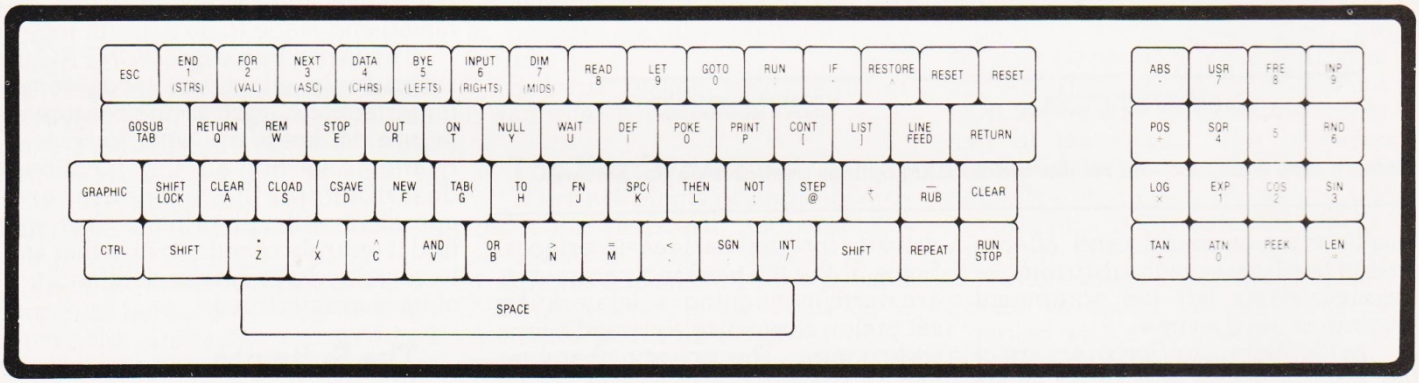
editing, Auto, Renumber, Kill, Find, and preset phrases called by single keys. Quality Software's DPX extends the Development PAC by providing extra commands and automatic setting for the I/O drivers to suit each ROMPAC function. The word processor has also been extended to adapt it to a particular printer.

All this is mostly gilt on the gingerbread, the extensions making good programs even better. On a broader basis, there are a number of important utilities. Extended BASIC is available in tape or disc form, and gives full Microsoft implementation, while CP/M is inherent in the disc system, which includes a family of utility programs. There is also a BASIC compiler, which in one instance produced machine code that would complete in around one second a process that took over a minute in BASIC. A useful thing to have around...

Since Exidy have a high reputation in the arcade games field, it is only to be expected that their



Exidy's own monitor and integral disc unit. The quality of finish seems to be exceptionally high on both the computer and its associated peripherals.

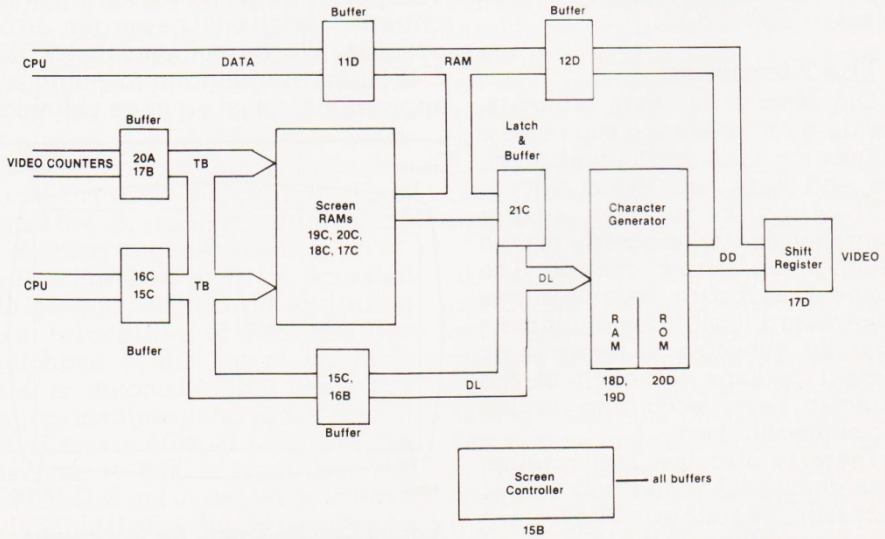


The keyboard overlay showing the locations of the single-key BASIC commands. The keyboard can be used in five different modes including user-defined graphics.

Sorcerer would be successful in providing games for home use. Sargon chess, Fastgammon and the Scott Adams Adventures are perhaps best known, but practically any game published in a magazine for BASIC or Z80 machine code can be adapted to a Sorcerer with ease, and usually benefits by the adaptation. This also applies to more serious programs.

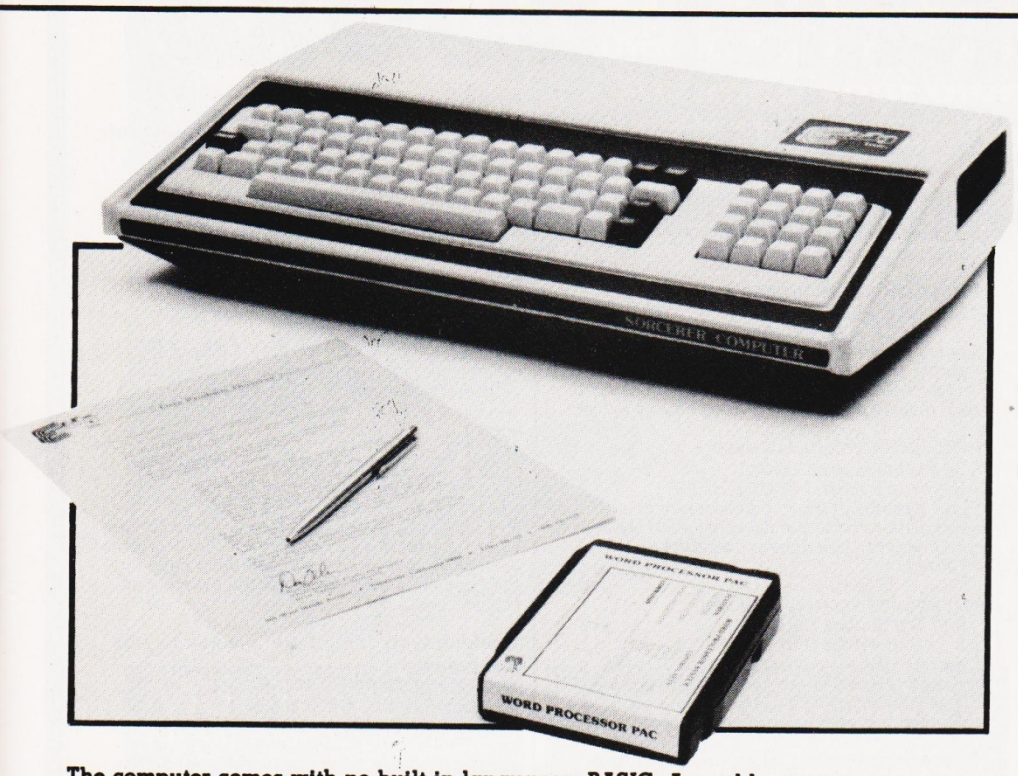
The Documentation

With our professional outlook on computing, we see the documentation of the Sorcerer as its weakest point. It has almost become a standing joke that the manuals so often say that you should experiment to find out what a program can do. The information you want is usually given somewhere, but finding it may



It takes all this to handle the screen of the Sorcerer, mainly because of the user-defined graphics capability.

SORCERER REVISITED



The computer comes with no built-in languages; BASIC, Assembler or even Applications Programs can be fitted as you need them by plugging in a ROM PAC (T). This fits into the slot at the top right-hand side of the unit.

be quite a task. However, it must be said that this applies to documentation from all sources, not just from Exidy themselves. Perhaps we are being over-critical.

It must also be said that most of the problems that have arisen have been solved without too much difficulty, but it would be much better if the problems could be anticipated, and the answers produced in advance.

Analysis

In using the Sorcerer, we have found relatively few problems not of our own making. The premature carriage return after part of a BASIC line has been erased was never a serious snag, and we understand that this has been cured in the latest version of the BASIC ROMPAC, along with other revisions. Certain programs which make enthusiastic use of the variable parameters available, and fail to reset to normal on exit, have given us a few headaches, but we know what to do about that now. (Reset!!) In general, we find the machine pleasantly docile and workmanlike.

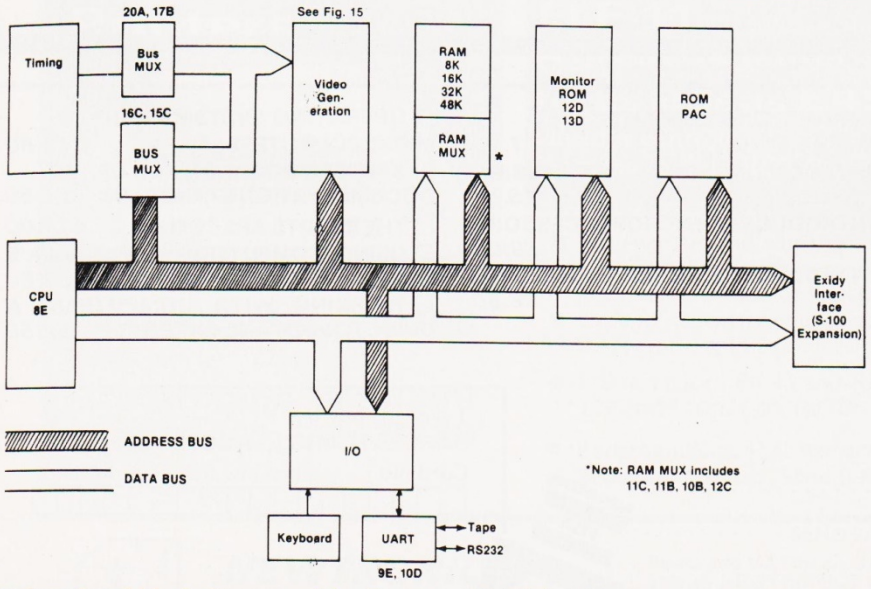
General Availability

Since we have found our Sorcerer so much to our liking, why is so little of them seen in shops, advertisements and in magazines?

First, it must be admitted that the Sorcerer is not in the lowest price bracket. One would not expect it to be, given its range of standard facilities. In the long run, it could prove to be cheaper than some low-cost machines which require numerous accessories to bring them to a similar standard. It is therefore likely to appeal most to the buyer who knows just what he wants, rather than to the beginner who is feeling his way into new territory. Some retailers may consider that this places too severe a restriction on the possible market.

Next, there was a time when the future of the Sorcerer was in doubt, because Exidy wanted to sell off that side of their business. We bought during that period, but the uncertainty discouraged others. Now that Exidy have reorganised, setting up a separate company deal with such equipment as the Sorcerer, the picture has changed — but the effects of the hiatus have not completely disappeared.

Incidentally, the announcement that Sorcerers for Europe were to be made in Holland failed to add that in American eyes Britain is not part of Europe, and British supplies will continue to come from the States. Liveport Data Products, of The Ivory Works, St Ives, Cornwall, continue to act as main agents and provide repair facilities.



The functional block diagram of the Sorcerer. The Video Generation segment can be seen in greater detail on the left.

The Last Word

Another factor influencing the Sorcerer is that whereas many magazine pages are filled with snippets of advice on how to overcome the defects of certain popular machines, there is much less to be said about Sorcerer snags! Also, we are well aware that any Sorcerer program using extensive graphics would probably prove merely frustrating to anyone who tried to adapt the program to a lesser machine.

However, Sorcerers are still selling well, and each extra one in use is likely to catch the eye of a potential user who wants something a bit better than he has seen elsewhere. The Sorcerer is not a 'glossy' machine, but it is a sound and willing workhorse.

Specialist Books

Choosing programs for microcomputers
1980 J E Lane *£9.00*
A5 138pp P ISBN 0 85012 255 4
Looks at application packages for micros describing what they are, the benefits they offer and their use on microcomputers. Guidelines for obtaining packages and for identifying the best product are given.

Elements of BASIC
1979 R Lewis and B H Blakeley *£9.00*
A5 200pp P ISBN 0 85012 118 3
Introduces the BASIC language, covering the mathematical, non-numeric and data processing facilities. Generally machine independent with supplements to show the effect of a number of different implementations.

Graphics on microcomputers
1981 J E Lane *£4.00*
A5 44pp P ISBN 0 85012 333 X
Explores the type of graphics becoming increasingly available in low cost systems. Illustrates the facilities available and takes a closer look at graphics picture building techniques.

Information handling by microcomputers
1981 J E Lane *£4.00*
A5 60pp P ISBN 0 85012 334 8
Examines the field of information handling on microprocessors across the whole spectrum of micro applications. Aims to promote an awareness of current practices and trends.

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Introducing computer programming
1979 Reprint W G Collin *£11.50*
A5 364pp P ISBN 0 85012 210 4
A machine language independent textbook for the beginner, providing all the necessary basic information needed by someone starting on a computer programming career.

Introducing data processing
1980 NCC *£6.50*
A5 237pp P ISBN 0 85012 245 7
Covers the requirements of syllabi for introductory courses. Provides a comprehensive and accessible introduction to data processing. Assumes no previous knowledge of the subject.

Introducing microprocessors
1979 G L Simons *£9.00*
A5 177pp P ISBN 0 85012 209 0
Gives a profile of the microprocessor scene paying attention to typical application areas together with hardware and software information.

Introducing word processing
1981 G L Simons *£8.50*
A5 180pp P ISBN 0 85012 320 8
Describes the main characteristics of word processing and discusses its advantages over conventional typewriting. Communication, maintenance, security and costs are considered.

Operating systems for microcomputers
1981 J E Lane *£3.50*
A5 77pp P ISBN 0 85012 277 5
Establishes the requirements of operating systems for microcomputers in both commercial and industrial application areas and examines the facilities provided in a number of current products.

Student notes on NCC DP documentation standards
1978 NCC *£5.50*
A5 100pp P ISBN 0 85012 339 9
A subset of the full documentation standards for use by students on courses where NCC standards are part of the syllabus.

The robots are coming
1974 F H George & J D Humphries (eds)
£10.00
A5 188pp P ISBN 0 85012 114 0
Gives a general background to current developments in artificial intelligence research and looks at where these developments could be leading.

Using computers — a manager's guide
1980 M Peltu *£7.50*
A5 180pp P ISBN 0 85012 241 4
Intended to help managers implement computer systems effectively in an organisation. Provides an introduction for user management covering the topics of planning and control plus human factors.

Working with computers: a guide to jobs and careers
1975 *£2.50*
A5 86pp P ISBN 0 85012 126 4
A general introduction to computing as a career for school leavers. Covers how a computer is used, what types of job exist and how to train for them.

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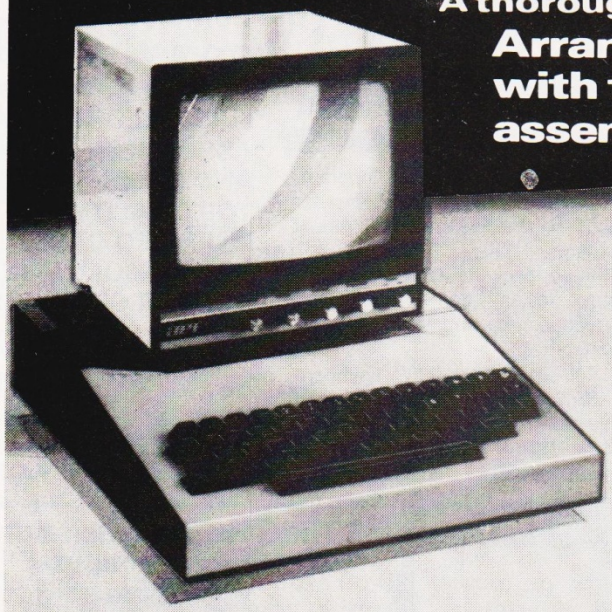

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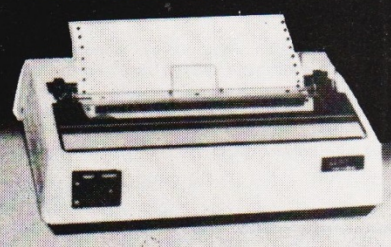

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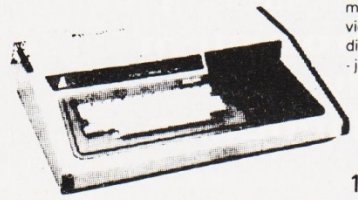

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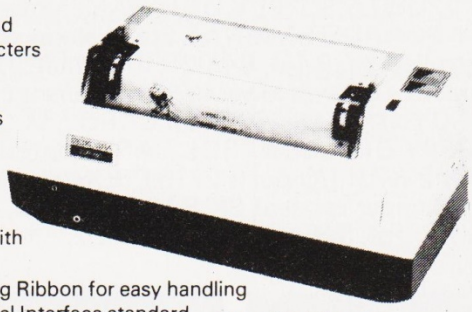

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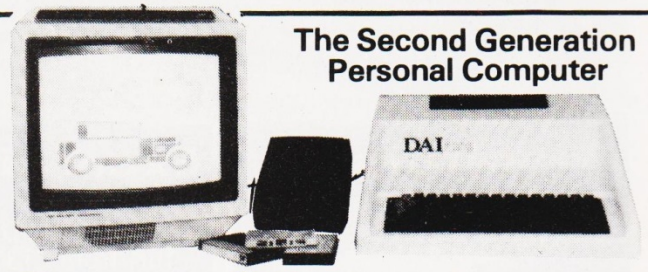

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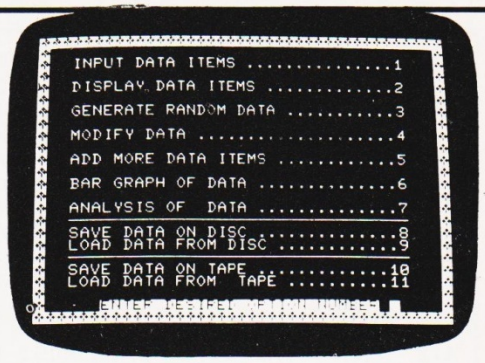

To the cynic, a statistic is a damned lie but to the politician, a statistic is a white lie. To the scientist and engineer, a statistic is a mathematically acceptable guess used as a last resort when knowledge is feeble or too expensive to obtain. Unfortunately, statistics is a branch of mathematics which is both fascinating and repellant. It is fascinating because it promises so much and repellent because even simple exercises involve the manipulation of a depressing amount of data. Scientific calculators which boast of buttons labelled STD/DEV, $\bar{X}$ etc, tend to be the least used on the keyboard...I have never quite understood exactly what the result means even after they are pushed. This admission is a strange advertisement for the accompanying program and is almost certain to evoke amazement at the cheek of the writer. There are two excuses for this: a programmer is not necessarily an expert on the subject of the program, neither is it necessary or in some cases even desirable that he/she should be. Experts have a habit of assuming too much knowledge of the relevant jargon and their superiority shows through in the way they expect the poor operator to respond to the cryptic screen messages. It is far better for the expert to explain (or rather 'explain') the basic techniques and formulas, leaving the programmer to organise the presentation. But in this case I was in difficulty again. Either my colleagues didn't know much about statistics, mumbling something like 'I did it in Higher National but I've forgotten it all now', or those who were enlightened failed completely to translate their knowledge in understandable terms. In the end I spent a miserable and to a large extent unproductive weekend trying to wrest a few unequivocal definitions from a battered textbook. I now know about something called the Gaussean Law of Error...at least I can draw the curve! I also became aware of the meaning of 'upper quartiles', a term which hitherto had only appeared in obscure union literature during the hostile phases of a pay claim. Apparently, civil servants (I confess to being one) cannot claim pay parity with private sector employees if they happen to be in the ***upper*** quartile. Great pity this ...it means Bognor Regis instead of the Bahamas. However, the weekend's labour was enough to convince me that a computer program which provided an easy method of entering and modifying statistical data would certainly help anyone to try out the various lengthy examples which appear to be vital in gaining confidence in the field. The actual analysis of the data is the comparatively easy part and can be expanded according to the knowledge and requirements of individuals. The program must therefore be considered a data input skeleton which could form a useful starting point.

The Program

The program was intended for a 16K PET and the DIMension statement of 1000 at line 180 reflects this in allowing for 1000 data items. To fit into 8K models, reduce this and remove the REMarks and condense the screen messages until the amnesia is conquered. Also the POKE 158,0 in line 1760 must be changed to POKE 525,0 to cater for the revised keyboard buffer pointer.

The options available can be seen by glancing through lines 210 to 330. Apart from entering raw data from the keyboard, there is provision for injecting random data which should prove useful to observe and quick to try out. As a by-product, it enables the randomness of the computer's random number generator to be investigated...this could be a disappointing exercise.

The lowest and highest random integer can be defined by an INPUT statement. A useful gimmick is the provision of a bar-chart display although only the first 40 data items are available. It would be a simple modification to alter the subroutine at line 1890 to employ the so-called 'high resolution' graphics (which is really only double-resolution). Even this would only display the first 80 data items, which bearing in mind the relatively enormous amount of data required for even a 'small' random sample, would only be a marginal improvement.

The data can be stored and retrieved on cassette tape or the Commodore twin disc unit. If disc loading is not required, just remove lines 2070 to 2330 and make the appropriate modification to the ON GOTO in line 370.

Conversion to other systems should prevent no real problems: all the graphics have been converted to CT's standard codes. The only particular oddities are the POKEs just mentioned and the subroutine at 1830 which uses the keyboard as an I/O device to prevent bomb-outs.

Disc and tape saving/loading routines are system dependent and should be replaced with suitable alternatives for your machine.

The analysis, as previously explained, is sparse but includes the mean, maxima, sum, variance and standard deviation. To increase the power of the analysis, the statistical specialist can add some extra mathematics in the area of lines 1310 to 1590.

Program Listing

```
180  DIM D(1000)
190  PRINT CHR$(147):GOSUB 2360:REM**CLEARS
     SCREEN
200  PRINT
210  PRINT TAB(3)"INPUT DATA ITEMS.......1":
     PRINT
220  PRINT TAB(3)"DISPLAY DATA ITEMS.....2":
     PRINT
230  PRINT TAB(3)"GENERATE RANDOM DATA...3":
     PRINT
240  PRINT TAB(3)"MODIFY DATA............4":
     PRINT
250  PRINT TAB(3)"ADD MORE DATA ITEMS....5":
     PRINT
260  PRINT TAB(3)"BAR GRAPH OF DATA......6":
     PRINT
270  PRINT TAB(3)"ANALYSIS OF DATA.......7"
280  PRINT TAB(3)"[24^#]"
290  PRINT TAB(3)"SAVE DATA ON DISC......8"
300  PRINT TAB(3)"LOAD DATA FROM DISC....9"
310  PRINT TAB(3)"[24^#]"
```

```
320  PRINT TAB(3)"SAVE DATA ON TAPE.....10"
330  PRINT TAB(3)"LOAD DATA FROM TAPE...11":
     PRINT
340  PRINT TAB(6)"[REV]ENTER DESIRED OPTION
     [OFF]";
350  GOSUB 1840:K$=I8$
360  IF VAL(K$)<1 OR VAL(K$)>11 THEN 350
370  ON VAL(K$) GOTO 380,830,700,950,1060,
     1080,1290,2070,2190,2540,2700
380  PRINT CHR$(147):PRINT TAB(240)
390  PRINT "[7 SPC]NOTE THE FOLLOWING :-":
     PRINT
400  PRINT "[40^#]"
410  PRINT TAB(3)"1. DATA MUST BE [REV]
     NUMERIC[OFF]":PRINT:PRINT
420  PRINT TAB(3)"2. PRESS [REV]RETURN[OFF]
     AFTER EACH ITEM":PRINT:PRINT
430  PRINT TAB(3)"3. KEY [REV]END[OFF] TO
     TERMINATE INPUT":PRINT
440  PRINT "[40^#]":PRINT
450  GOSUB 1750
460  CLR:DIM D(1000):E$="ENTER ":IT$="ITEM
     NUMBER "
470  PRINT CHR$(147):F=0:N=1:REM**FLAG FOR
     ADD DATA OPTION
480  IF F=1 THEN N=NM+1
490  PRINT "[40^#]"
500  E$="ENTER ":IT$="ITEM NUMBER "
510  PRINT E$+IT$;N TAB(26)
520  GOSUB 1830
530  PRINT
540  IF I8$="END" THEN N=N-1:NM=N:GOTO 600
550  D(N)=VAL(I8$):N=N+1
560  IF D(N-1)>DM THEN DM=D(N-1)
570  PRINT "[40^#]"
580  F=0
590  GOTO 500
600  PRINT
610  PRINT CHR$(147):PRINT TAB(240)
620  PRINT "THE DATA FILE MUST BE GIVEN A
     [REV]NAME[OFF]":PRINT
630  PRINT "THE NUMBER OF CHARACTERS MUST
     NOT EXCEED":PRINT
640  PRINT TAB(12)"SIXTEEN"
650  PRINT TAB(12)"[7^8]":PRINT:PRINT
660  PRINT "ENTER THE [REV]NAME[OFF] NOW";
670  GOSUB 1840
680  TN$=I8$
690  GOTO 190
700  PRINT CHR$(147):PRINT TAB(240):DM=1:
     X=RND(-TI)
710  PRINT "HOW MANY RANDOM INTEGERS ?";
720  PRINT TAB(30):GOSUB 1840:NM=VAL(I8$):
     PRINT:PRINT
730  PRINT "LOWEST INTEGER WANTED ?";
740  PRINT TAB(30):GOSUB 1840:M=VAL(I8$):
     PRINT:PRINT
750  PRINT "HIGHEST INTEGER WANTED ?";
760  PRINT TAB(30):GOSUB 1840:H=VAL(I8$):
     PRINT:PRINT:PRINT:PRINT
770  PRINT TAB(10)"[REV]WAIT A FEW SECONDS
     [OFF]"
780  FOR N=1 TO NM
790  D(N)=INT((H-M+1)*RND(1)+M)
800  IF D(N-1)>DM THEN DM=D(N-1)
810  NEXT N
820  GOTO 610
830  PRINT CHR$(147):IT$="ITEM NUMBER "
840  PRINT TAB(10)"[REV]DATA HELD ON
     FILE[OFF]":PRINT:PRINT
     PRINT:PRINT
850  PRINT TAB(6)"DATA IS NAMED ";TN$:PRINT
860  FOR S=1 TO NM
870  IF P=17 THEN PRINT:GOSUB 1750:P=1:
     PRINT CHR$(147)
880  PRINT IT$;S;TAB(25)D(S)
890  P=P+1
900  NEXT S
910  PRINT "[40^8]"
920  PRINT:PRINT TAB(13)"[REV]END OF
     DATA[OFF]"
930  P=0:F=0
940  PRINT:GOSUB 1750:GOTO 190
950  PRINT CHR$(147)
960  PRINT TAB(5)"[REV]MODIFY SELECTED DATA
     ITEMS[OFF]":PRINT:PRINT:PRINT
970  PRINT "ENTER DATA ITEM NUMBER ";:GOSUB
     1830:PRINT
980  IF VAL(I8$)<=NM THEN PRINT:GOTO 1000
990  PRINT:PRINT TAB(5)"[REV]NO SUCH DATA
     ITEM[OFF]":PRINT:GOTO 970
1000 I8=VAL(I8$):PRINT:PRINT
1010 PRINT "DATA ITEM ";I8;" IS ";D(I8):
     PRINT:PRINT:PRINT
1020 PRINT "ENTER THE NEW VALUE ";:GOSUB
     1830
1030 D(I8)=VAL(I8$)
1040 GOSUB 2020
1050 GOTO 190
1060 PRINT CHR$(147):F=1:GOTO 480
1070 PRINT "ENTER THIS NOW...";
1080 PRINT CHR$(147):PRINT TAB(240)
1090 PRINT "DUE TO LIMITATIONS IMPOSED BY
     THE SCREEN":PRINT
1100 PRINT "WIDTH, THE BAR GRAPH ONLY
     DISPLAYS THE":PRINT
1110 PRINT "FIRST 38 DATA ITEMS":PRINT:PRINT
1120 PRINT "[40^#]":PRINT:PRINT
1130 GOSUB 1760
1140 PRINT CHR$(147):GOSUB 2020
1150 PRINT:PRINT:PRINT TAB(1)"-";DM
1160 N=1
1170 FOR X8=1 TO 38
1180 IF DM=0 THEN DM=1E-30
1190 N8=20*D(N)/DM
1200 GOSUB 1890
1210 N=N+1
1220 NEXT X8
1230 GOSUB 1970
1240 PRINT "[4 CU][8 CR]"
1250 GOSUB 1750
1260 N=N-1
1270 GOTO 190
1280 REM**CALCULATIONS ON THE DATA
1290 PRINT CHR$(147):V=0:T=0
1300 PRINT:PRINT:PRINT:PRINT:PRINT
1310 PRINT TAB(9)"[REV]ANALYSIS
     PROCEEDING[OFF]"
1320 IF NM=0 THEN NM=1E-30
1330 FOR N=1 TO NM:T=T+D(N):NEXT
1340 ME=T/NM
1350 FOR N=1 TO NM
1360 V=V+(D(N)-ME)^2
1370 NEXT
1380 V=V/NM
1390 SD=SQR(V)
1400 L1=ME-SD:H1=ME+SD
1410 L1=INT(100*L1+.5)/100
1420 H1=INT(100*H1+.5)/100
1430 L2=ME-2*SD:H2=ME+2*SD
1440 L2=INT(100*L2+.5)/100
1450 H2=INT(100*H2+.5)/100
1460 L3=ME-3*SD:H3=ME+3*SD
1470 L3=INT(100*L3+.5)/100
1480 H3=INT(100*H3+.5)/100
1490 PRINT CHR$(147):GOSUB 2360:PRINT:
     PRINT TAB(12)"ANALYSIS"
1500 IF NM=1E-30 THEN NM=0
1510 IF DM=1E-30 THEN DM=0
1520 PRINT TAB(12)"[8^8]":PRINT
1530 PRINT TAB(2)"NUMBER OF DATA ITEMS";
     TAB(25);NM:PRINT
1540 PRINT TAB(2)"SUM OF THE DATA ITEMS";
     TAB(25);T:PRINT
1550 PRINT TAB(2)"MAXIMUM DATA ITEM";
     TAB(25);DM:PRINT
1560 PRINT TAB(2)"MEAN VALUE";TAB(25);ME:
     PRINT
```

```
1570  PRINT TAB(2)"VARIANCE";TAB(25);V:PRINT
1580  PRINT TAB(2)"STANDARD DEVIATION";
      TAB(25);SD:PRINT:PRINT:PRINT
1590  GOSUB 1760
1600  PRINT CHR$(147)
1610  PRINT "ASSUMING THE DATA WAS FREE FROM
      BIAS,":PRINT
1620  PRINT "THESE ASSUMPTIONS ARE
      REASONABLE:-"
1630  PRINT "[40^#]"
1640  PRINT "68% OF THE 'POPULATION' SHOULD
      HAVE":PRINT
1650  PRINT "VALUES BETWEEN ";L1;" AND ";H1
1660  PRINT "[40^#]"
1670  PRINT "95% OF THE 'POPULATION' SHOULD
      HAVE":PRINT
1680  PRINT "VALUES BETWEEN ";L2;" AND ";H2
1690  PRINT "[40^#]"
1700  PRINT "99.5% OF THE 'POPULATION SHOULD
      HAVE":PRINT
1710  PRINT VALUES BETWEEN ";L3;" AND ";H3
1720  PRINT "[40^#]"
1730  GOSUB 1760
1740  GOTO 190
1750  REM**ANY KEY ROUTINE
1760  PRINT TAB(6)"[REV]PRESS ANY KEY TO
      CONTINUE[OFF]":POKE 158,0:REM**POKE
      DISABLES THE 'STOP' KEY
1770  GET K8$:IF K8$="" THEN 1770
1780  RETURN
1790  REM**DELAY N8 SECONDS ROUTINE
1800  K8=TI:REM**TI IS PET'S INTERNAL CLOCK
1810  IF TI<K8+N8*60 THEN 1810
1820  RETURN
1830  REM**IDIOT-PROOF INPUT ROUTINE, ONLY
      FOR PET
1840  OPEN 1,0:REM**DEVICE 0 IS THE KEYBOARD
1850  INPUT#1,I8$
1860  IF I8$="" THEN 1850
1870  CLOSE 1
1880  RETURN
1890  REM**VERTICAL BAR OF N8
1900  REM**AT CO-ORDINATE X8
1910  IF N8>25 THEN N8=25
1920  A8=33688+X8:REM**BOTTOM LEFT CORNER OF
      PLOT
1930  FOR Z8=0 TO N8-1
1940  IF N8=0 THEN 1960
1950  POKE (A8-40*Z8),117:NEXT:RETURN:
      REM**CALCULATE POSITION AND PLOT
1960  NEXT:RETURN
1970  REM**TOP LEFT POSITION AND LINE LENGTH
1980  A8=32768:B8=40
1990  FOR C8=3 TO 23
2000  POKE A8+B8*C8,46
2010  NEXT:RETURN
2020  DM=D(1):REM**FIND THE MAX VALUE
2030  FOR N=1 TO NM-1
2040  IF D(N+1)>DM THEN DM=D(N+1)
2050  NEXT N
2060  RETURN
2070  REM**SAVE ON DISC
2080  PRINT CHR$(147):PRINT TAB(206)"[REV]
      WAIT FOR DISC TO LOAD[OFF]"
2090  A$="0:":C$=",SEQ,WRITE"
2100  B$=A$+TN$+C$
2110  OPEN 1,8,5,B$:REM**DISC IS DEVICE 8
2120  PRINT#1,STR$(NM);CHR$(13);
2130  PRINT#1,STR$(DM);CHR$(13);
2140  FOR S=1 TO NM
2150  PRINT#1,STR$(D(S));CHR$(13);
2160  NEXT S
2170  CLOSE 1
2180  GOTO 190
2190  REM**LOAD FROM DISC
2200  PRINT CHR$(147):PRINT TAB(240)
2210  PRINT "ENTER FILE [REV]NAME[OFF]..";:
      GOSUB 1830:TN$=I8$
2220  PRINT CHR$(147):PRINT TAB(203)"[REV]
      WAIT FOR DISC TO UNLOAD[OFF]"
2230  A$="0:":C$=",SEQ,READ":B$=A$+TN$+C$
2240  OPEN 1,8,5,B$:REM**DISC IS DEVICE 8
2250  INPUT#1,NM$
2260  INPUT#1,DM$
2270  FOR S=1 TO VAL(NM$)
2280  INPUT#1,D$
2290  D(S)=VAL(D$)
2300  NEXT S
2310  CLOSE 1
2320  NM=VAL(NM$)
2330  DM=VAL(DM$)
2340  GOTO 190
2350  REM
2360  REM**PRINT BORDERS
2370  A8=32768:B8=40
2380  FOR C8=0 TO 39:REM**HORIZONTALS
2390  POKE A8+C8,216:POKE A8+C8+B8*23,216:
      NEXT C8
2400  FOR C8=1 TO 23:REM**VERTICALS
2410  POKE A8+B8*C8,216:POKE A8+B8*C8+39,216:
      NEXT C8
2420  RETURN
2430  REM**PRODUCE AXES
2440  A8=32768:B8=40
2450  FOR C8=3 TO 23
2460  POKE A8+B8*C8,46
2470  NEXT C8:RETURN
2480  REM**FIND DM
2490  DM=0
2500  FOR L=1 TO NM+1
2510  IF D(L-1)>DM THEN DM=D(L-1)
2520  NEXT L
2530  RETURN
2540  PRINT CHR$(147):REM**SAVE ON TAPE
2550  PRINT:PRINT:PRINT
2560  PRINT TAB(3)"1. HAVE YOU INSERTED A
      CASSETTE?":PRINT
2570  PRINT TAB(3)"2. HAVE YOU REWOUND IT?":
      PRINT
2580  PRINT TAB(3)"3. HAVE YOU STOPPED THE
      MOTOR?":PRINT:PRINT
2590  PRINT TAB(6)"WHEN YOU ARE READY THEN":
      PRINT:PRINT
2600  GOSUB 1760
2610  OPEN 1,1,1,TN$:REM**TAPE IS DEVICE 1
      1 INDICATES A WRITE
2620  PRINT#1,NM
2630  PRINT#1,DM
2640  FOR N=1 TO NM
2650  PRINT#1,D(N)
2660  NEXT N
2670  PRINT#1:REM**WRITE A BLANK BLOCK
2680  CLOSE 1
2690  GOTO 190
2700  PRINT CHR$(147):REM**LOAD FROM TAPE
2710  PRINT "WHAT IS THE [REV]NAME[OFF] OF
      THE FILE ?":PRINT
2720  CLR:DIM D(1500)
2730  GOSUB 1830:PRINT:PRINT
2740  TN$=I8$
2750  PRINT TAB(3)"1. HAVE YOU INSERTED THE
      DATA TAPE?":PRINT
2760  PRINT TAB(3)"2. HAVE YOU REWOUND IT?":
      PRINT
2770  PRINT TAB(3)"3. HAVE YOU STOPPED THE
      MOTOR?":PRINT:PRINT
2780  PRINT TAB(6)"WHEN YOU ARE READY THEN":
      PRINT:PRINT
2790  GOSUB 1760
2800  OPEN 1,1,0,TN$:REM**TAPE IS DEVICE 1
      0 INDICATES A READ
2810  INPUT#1,NM
2820  INPUT#1,DM
2830  FOR N=1 TO NM
2840  INPUT#1,D(N)
2850  NEXT N
2860  CLOSE 1
2870  GOTO 190
```

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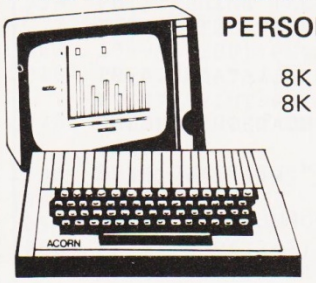

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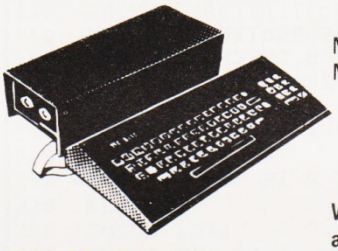

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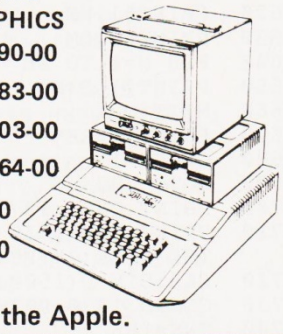

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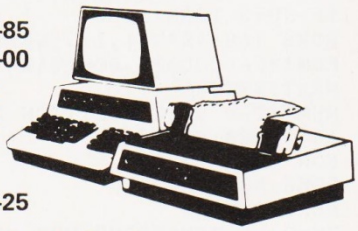

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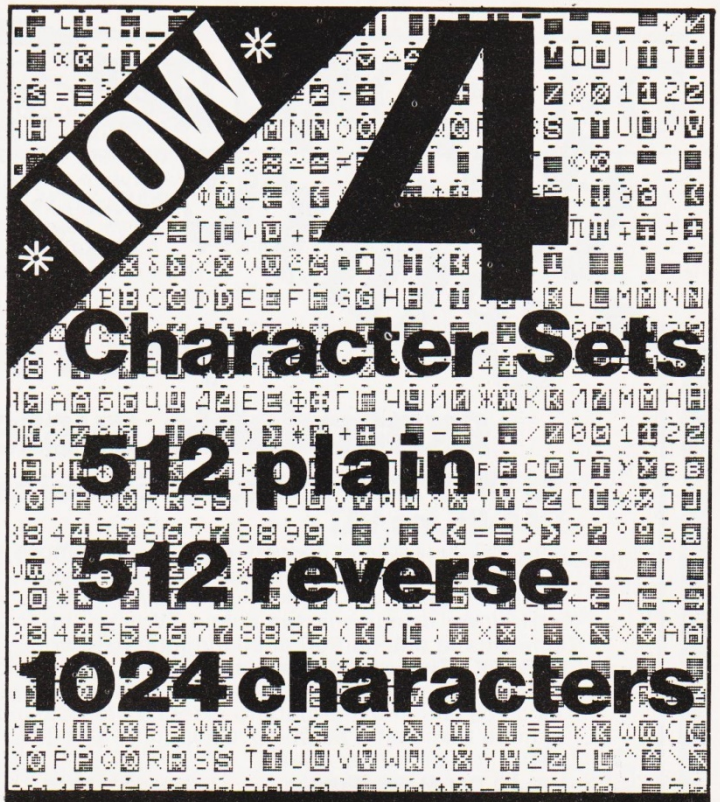

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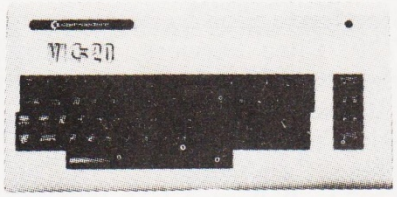

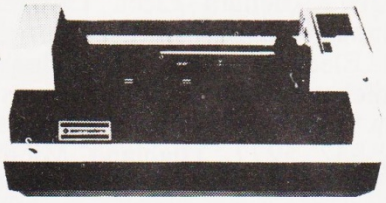

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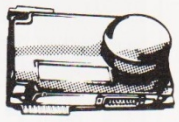

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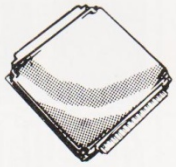

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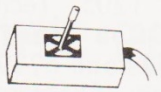

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NUMBER CRUNCHING

Reverse Polish may sound like Double Dutch if you are used to algebra but it's the logical way to process numerical information

This is the first of two articles describing how the most important part of a high level language compiler works. In Part One the principles involved; the LIFO stack and Reverse Polish notation, are explained and a BASIC program to convert arithmetic expressions into Reverse Polish is presented. Part Two examines how to compile this notation into 6502 assembly code — ie how to generate a compiler for the Apple or the PET etc. This program could easily be modified for use with another processor, such as the 6800 or 6809. From these articles, readers without knowledge of assembly language will learn something about how high level language compilers work and those with more advanced knowledge will find the techniques described useful in writing their own compilers.

Why Bother?

One of the most difficult tasks confronting the budding software expert is the translation of what appear to be simple arithmetic expressions into assembly language. After all, we have high level languages such as BASIC that swallow A+B*C and spit out the answer in one statement.

The reason is two-fold. First, the implementation of high level languages is still poor on most micros. Second, there are still few such languages available on micros. Both these reasons should encourage an interest in the production of new compilers. It should also be pointed out (perhaps 'admitted' is better) that writing a compiler is one of the most difficult projects that can be undertaken. So if you are bored with writing games of the 'ZAP the enemy' type, try a compiler — for an existing language or, even more or a challenge, for one of your own inventions.

The trouble with expressions like A+B*C is that more than one operation, in this case two (one addition and one multiplication), have to be carried out before the result is obtained. In general computers can only do one thing at a time so any complex expression would have to be split down as in the following example:

"Add A to B"
"Multiply the result by C"

Even this description is incomplete (in fact it is also wrong if applied to the expression A+B*C but more of this later) for the computer has to put the result of adding A to B somewhere, ie in a temporary location, before multiplying by C.

These temporary locations have to be created automatically as required by the translation program and it is something of a problem to keep their number small. It is possible to avoid using temporary storage locations as such by the use of a 'stack'. This also brings other advantages in that the translation program is simpler.

A LIFO Stack

A 'Last In, First Out' (LIFO) stack is very easy to understand. A good model is a shunting yard. If we consider a railway line as in Fig. 1 with three wagons, A, B and C, then if we shunt A, B and C into the siding in that order (Fig. 2) then the first wagon out will be C, the last in. Next out will be B and then A.

In computer terms, a stack is an area of memory and two instructions, PUSH (usually abbreviated to PSH) and PULL (usually abbreviated to PUL), are used to place an item. To use our railway sidings model/analogy once again, if a wagon is outside the siding a PSH is required to put it inside; if a wagon is in the siding a PUL removes it.

Thus our shunting sequence would correspond to:

```
PSH  A into siding
PSH  B into siding
PSH  C into siding
PUL  removes C
PUL  removes B
PUL  removes A
```

A stack can be implemented in BASIC as a string of characters, eg Z$. Pushing an item, or character on to the stack is:

```
Z$ = "character" + Z$
```

where '+' in this case means concatenation — simply joining the two strings to form a longer string.

Pulling an item from the stack is:

```
"character" = LEFT$(Z$,1)
Z$ = RIGHT$(Z$,LEN(Z$)-1)
```

where LEFT$(Z$,n) gives the n left-hand characters of the string, LEN(Z$) gives the length of the string and RIGHT$(Z$,n) give the right n characters of the string.

At this point it might be helpful to write a program, namely to reverse the order of a string of letters. The answer is given at the end of the article but try it for yourself before looking at it in detail.

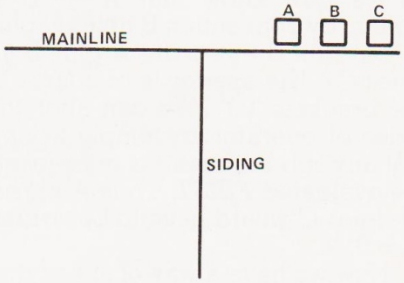


Fig. 1. The shunting yard before the trucks are 'pushed' into the stack...

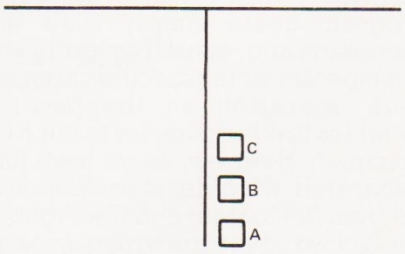


Fig. 2. ...and the result after they have been 'pushed'.

Order, Precedence And Reverse Polish!

To return to the reason why A+B*C is not 'add A to B then multiply by C', it is worth realising that you get a different answer from 'multiply B by C and then add A', which is in fact the correct interpretation: eg 2+3*4≠2+(3*4). That is to say, the *order* in which the calculation is carried out *is* important. How we define the order of evaluation of an arithmetic expression is to some extent arbitrary but it is usual to carry out all multiplications and divisions first and then any additions and subtractions. To express this in another way, we assign a precedence to each operator. For example, if we

assign a precedence of 1 to + and -; and a precedence of 2 to * and / and agree that operators of higher precedence are carried out first, then we are adopting the conventional rule. The usual precedences are given in Table 1.

+	1	
–	1	
*	2	
/	2	
+	3	UNARY +
–	3	UNARY –

Table 1. Precedence values for arithmetic operations.

So we now know that A + B*C means, by convention B times C plus A. But how do we write A plus B all times C? The answer is of course to use brackets '( )'. We can alter the order of operator by simply asking that any sub-expressions in brackets are evaluated ***FIRST.*** Thus A plus B all times C would have to be written (A+B)*C.

Now we have a way of specifying the order of evaluation we meet the main problem in the computer evaluation of arithmetic expressions. If the order of evaluation were strictly from left to right then a computer program could simply read the expression and, apart from problems of temporary storage, could carry out each operation on the pair of variables to either side (as in our first example). However, as we have just discovered, the order of evaluation is not from left to right and if we ignore this fact we obtain the wrong answer.

Life would be a lot easier if we could find some way of writing arithmetic expressions so that the order of evaluation was always from left to right. This would mean that as we scanned the expression each operation could be carried out as soon as it was encountered and brackets would be unnecessary. Such a notation exists and is called 'Reverse Polish' — so called because of the unpronounceability by English speakers of the name of its inventor, Lukasiewicz, a Polish logician.

An expression in Reverse Polish (RP) is evaluated by scanning from left to right until an operator is met. When this happens the operator is applied to the two variables immediately to its left. The result is considered to be left in the expression replacing all the variables and symbols involved. An example will make this clear.

Consider:

AB*C+

If we follow our rule, the first operator we encounter is '*' and the two variables to its left are A and B so we form A*B and put the result, T say, in place of AB* to give

TC+

To continue, the next operator is '+' and we form T+C. So, to put the original expression into conventional notation we have

(A*B)+C.

As an exercise try evaluating:

3,4*6+3/

The answer is given at the end of the article.

We could insist that everyone learns RP, which is what some calculator manufacturers have done, or we could convert standard arithmetic expressions into RP. Using the concept of a stack this is easy.

The Shunting Yard Algorithm

Obviously if we are going to read an RP expression from left to right but jump all over the place in an equivalent 'standard' expression then we are going to have to change the order of the operators when converting to RP. From the earlier example involving reversing a sequence of letters it can be seen that a stack is useful in changing the order of a set of symbols. It is this ability which lies at the heart of the shunting yard algorithm. The algorithm uses a stack to change the order of the operator so that all high precedence operators and brackets are evaluated first. It works like this:

If you encounter a variable name pass it to the output.
If you encounter an operator stack it (ie push it on to the stack) unless there is an operator already on the stack with a higher precedence.
If this is the case then the operator already on the stack should be carried out first so unstack it and pass it to the output.
Repeat until you can stack the operator and then move on to the next item in the expression.

Brackets can be dealt with by starting a new stack when the opening bracket is encountered and by finishing evaluation when the closing bracket is encountered. Usually we do not start a new stack but simply place a marker on the old stack to indicate where the bracket was encountered (this might as well be the opening bracket itself). The full shunting yard algorithm can be seen in Fig. 3.

Listing 1 shows a BASIC program that will convert any valid arithmetic expression into RP with examples of its output given after it. The only complication with the BASIC program lies in the use of the unary + and – signs. The minus in A–B has a different meaning from the one in –A, similarly the plus in A+B does not mean the same as the one in +A. The program detects these unary symbols by checking if an operator or a variable was the last thing to be processed. If it was an operator or nothing then a + is converted into a ? and a – into a ! to show that they are unary. In calculations an RP expression or a binary operator is treated in the usual way except that it acts only on the FIRST variable to its left. The only other comments on the program are:

W(I) is used to hold the precedence of the operators
Z$ is the stack and Z(I) contains the precedence of the items of the items on the stack.
MID$ A($,I,J) returns the J characters in the string starting at the Ith.

The parts of the program can be followed from the line numbers on Fig. 3.

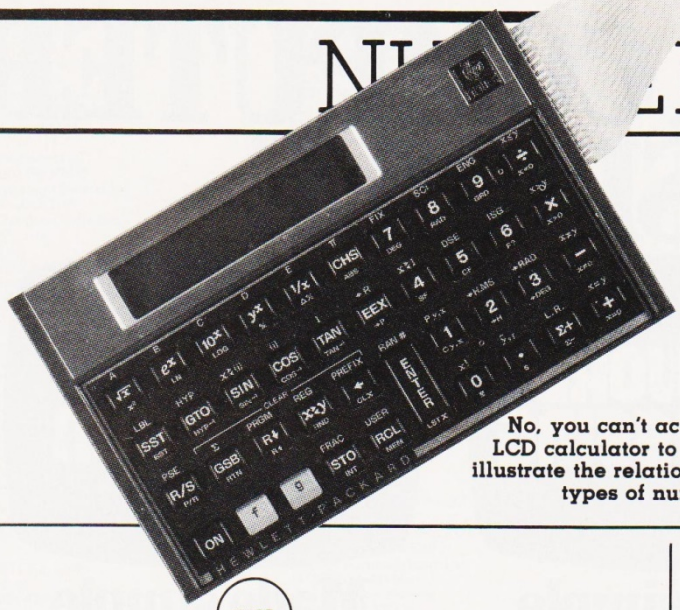
Summary

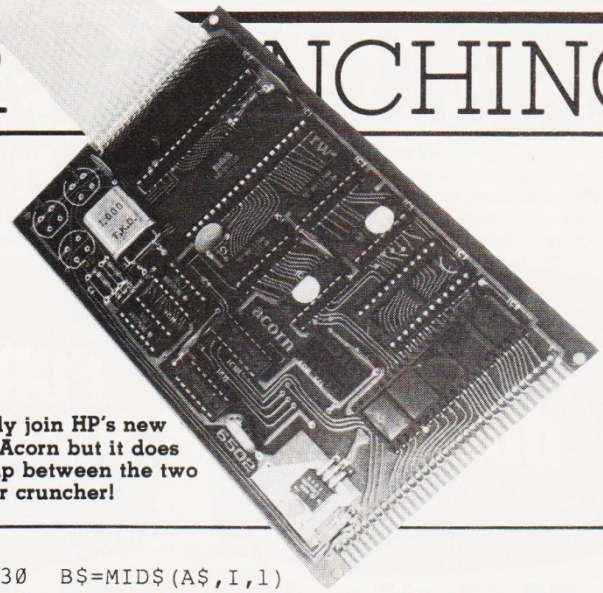
This article has introduced the reader to the LIFO stack and to Reverse Polish notation. A subroutine to convert an arithmetic expression to RP has been presented. Next month, again making use of the stack concept, we will show you how to compile an RP expression into 6502 assembly language (or into code for the 6800 or 6809 with certain modifications.) Oh, the answer to 3,4*6+3/ is 6.

```
10  INPUT A$
20  IF A$="" THEN GOTO 50
30  Z$=A$+Z$:REM**PUSH INPUT
    ONTO STACK
40  GOTO 10
50  IF Z$="" THEN STOP
60  A$=LEFT$(Z$,LEN(Z$)-1)
70  Z$=RIGHT$(Z$,LEN(Z$)-1)
80  PRINT A$
90  GOTO 50
```

This is the program to demonstrate the action of a LIFO stack.

NU[illegible]ER [illegible]NCHING





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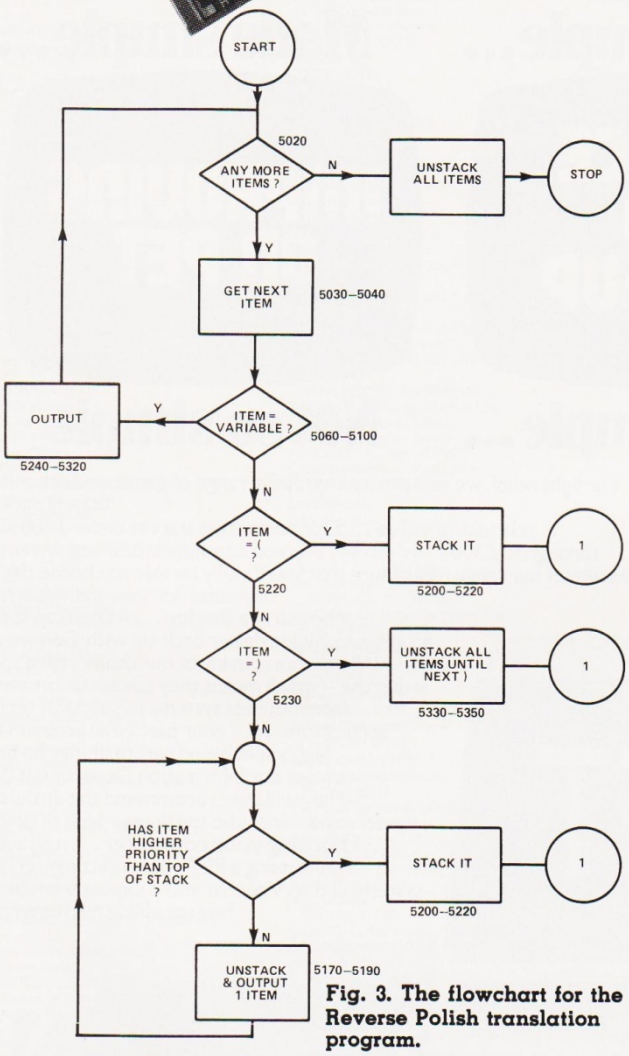


Fig. 3. The flowchart for the Reverse Polish translation program.

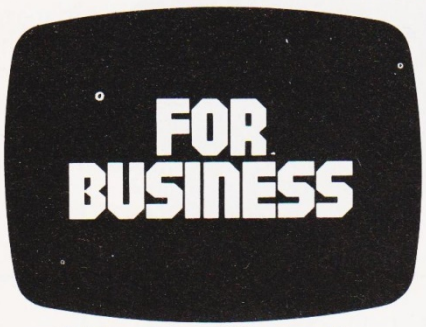
Program Listing

```
  10  DIM Z(25),W(5)
  20  U$="-+*/()"
  30  W(1)=1:W(2)=1:W(3)=2:W(4)=2:
      W(5)=0
  40  INPUT A$
  50  I=1
  60  GOSUB 5000
  70  PRINT A$,C$
  80  GOTO 40
4999  REM**REVERSE POLISH ROUTINE
5000  Z$="":C$="":X=1:O=1
5010  FOR J=1 TO 25:Z(J)=0:NEXT J
5020  IF LEN(A$)<I THEN 5420
5030  B$=MID$(A$,I,1)
5040  IF B$="[SPC]" THEN I=I+1:GOTO 5020
5050  K=0
5060  FOR J=1 TO 6
5070  IF B$=MID$(U$,J,1) THEN K=J
5080  NEXT J
5090  IF K=6 THEN 5330
5100  IF K=0 THEN 5230
5110  S=W(K)
5120  IF S=0 THEN 5200
5130  IF S=1 THEN 5380
5140  O=1
5150  IF X=1 THEN 5200
5160  IF Z(X-1)<S THEN 5200
5170  C$=C$+LEFT$(Z$,1)
5180  X=X-1:Z$=RIGHT$(Z$,LEN(Z$)-1)
5190  GOTO 5150
5200  Z(X)=S
5210  Z$=B$+Z$:X=X+1:I=I+1
5220  GOTO 5020
5230  O=0
5240  IF B$<"A" THEN 5280
5250  IF B$>"Z" THEN 5280
5260  C$=C$+B$
5270  I=I+1
5280  IF B$>"9" THEN 5020
5290  IF B$<"0" THEN 5020
5300  C$=C$+B$
5310  I=I+1
5320  GOTO 5020
5330  IF LEN(Z$)=0 THEN I=I+1:GOTO 5020
5340  B$=LEFT$(Z$,1):Z$=RIGHT$(Z$,LEN(Z$)-1):
      X=X-1
5350  IF B$="(" THEN I=I+1:GOTO 5020
5360  C$=C$+B$:GOTO 5330
5370  IF O=0 THEN 5140
5380  S=6
5390  IF B$="-" THEN B$="!"
5400  IF B$="+" THEN B$="?"
5410  GOTO 5140
5420  C$=C$+Z$
5430  RETURN
```

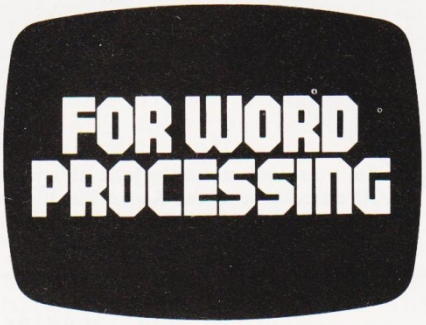
```
 RUN
? A+B
A+B                    AB+
? A+B*C
A+B*C                  ABC*+
? A*B+C
A*B+C                  AB*C+
? A*(B+C)
A*(B+C)                ABC+*
? -A+B
-A+B                   A!B+
? -(A+B)*C+(D*E)
-(A+B)*C+(D*E)         AB+!C*DE*+
? -(A+B)*(C-D)
-(A+B)*(C-D)           AB+!CD-*
```

A typical output from the above program. The entered algebraic expressions are converted to RPN.

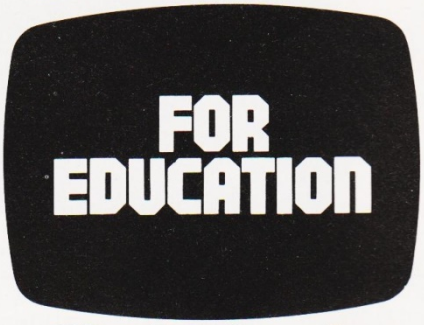
CHOOSING A COMPUTER MADE SIMPLE



Made simple...



Made simple...



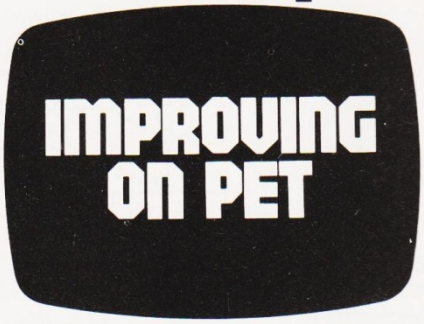
Made simple...



Made simple...



Made simple...



Not so simple

Choosing a computer is... Choosing a computer is more than just choosing a computer. That is, it's a lot more than just hardware. Mind you, PET stacks up very well when it comes to the computer itself. Because at Commodore we've been involved with microcomputers for over 20 years – in fact, many other manufacturers pay us the compliment of using our microchip for their own computers.

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COMMODORE PET
Quite simply, Britain's biggest selling microcomputer

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Company.....

Address.....

Tel:..... 39CT2

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Centralex – London Ltd
SE13, 01-318 4213-7
Chromasonic Electronics
N19, 01-263 9493/9495
Healey Management Services Ltd
E1, 01-247 2858/3149
Home and Business Computers
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SW1, 01-222 1122/5492
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EC4, 01-583 6774
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EC4, 01-236 2000
Micro Computation
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PAIGNTON, 526303
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PLYMOUTH, 260861
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PLYMOUTH, 662616 & 29038
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KILMARNOCK, 42972

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Northern Ireland Computer Centre Limited
HOLYWOOD, (02317) 6548

SUBMISSIONS

Are you interested in writing for our magazine? Or, to put it another way, are you interested in writing for your own magazine? Computing Today is always on the look-out for interesting articles, innovative programs and useful projects and we are sure there are many readers who have the capability to pass on their hard won knowledge to others. Not only will this make the magazine a better one, it will also put some money in *your* pocket to finance your computing further.

Featuring You

The main bulk of the magazine is usually taken up with feature articles, reviews, projects and general topics. Each of these articles attempts to convey the necessary information as clearly and concisely as possible, at the same time remaining easily readable. Articles of this nature can be thought of as similar to a school 'essay' in that they must have a beginning, a middle and an end. Diagrams and photographs are an enormous help to any article, the old adage of a picture being worth a thousand words holds very true in this case.

If you are a regular reader of the magazine you will know the 'style' in which we write. Generally each section of the article that deals with a new topic is given its own heading and, while not essential, headings do help to increase the readability of the final text. We prefer all copy to be typewritten on one side only of a page, using double line spacing and with large margins on each side of the text. However, this does *not* rule out the submission of hand-written material provided it is clearly legible and set out in a similar way.

All associated diagrams and photographs should be clearly labelled both as to their intended use and as to where they relate in the text. Circuit diagrams should follow the standard style of component designation and layout that is used throughout Computing Today. All components used in a given circuit must also be listed in a single table or Parts List to avoid any possibility of confusion.

Programming For All

In general the format for computer programs follows that of articles. We *cannot* accept any program that is not accompanied by a full listing, and TAPES ARE TOTALLY UNACCEPTABLE. While it is desirable to have a printed listing, it is not at all reasonable to expect everyone to have access to a printer so typewritten or even good handwritten copy will be considered.

Remember to include sufficient detail to enable people who don't own an identical piece of hardware to be able to follow your program. You must also include descriptions of any part of the software that is unique to your machine; SYS calls, POKEs etc. All graphics characters must be detailed with their associated codes and cursor controls should be presented in the CT standard format. The use of printers which give graphical output is acceptable provided all the graphics are fully expanded. It is often worth including a photograph or drawing of the display produced or an actual sample run if possible.

Remember that the frustration you feel when you can't run a program, due to lack of documentation, will be felt by everyone else if YOU send in a program in that same state!

Soft Spots?

The Softspot features are really programming ideas that are submitted by readers. Because of this they do tend to be for specific systems. They must be submitted in the same format as other programs, ie printed or typewritten, but will probably contain less general detail and more specific machine instruction. The more detailed a program submitted for a Softspot the more chance of it being considered as a feature in its own right!

Paying For It

It takes up to four working weeks for any submitted material to get through the system. At the end of this period a decision is made as to whether it is acceptable or not and, if it is, a letter will be sent informing you of its acceptance and the rate offered. If it is found unsuitable we will return the program or article at this stage.

If for any reason you feel the sum we are offering you is not in line with the amount you anticipated then you should discuss this with the Editor. (This is very unlikely as we pay some of the highest rates in the field.) All payments are made upon publication, that is you will receive your cheque in the same month as the magazine appears on the streets.

The Right To Copy

Once it has been published, copyright to the material passes to us. Under special circumstances this copyright may be retained by the author but this *must* be negotiated at the submission stage. Because we own the copyright it is a breach of publishing law to reproduce the material anywhere else without the express written consent of the Editor. Under no circumstances may a program be re-published for profit: the penalties are high.

Benefit To All

Writing for a magazine like CT not only gives you the pleasure of knowing that some 60,000 people read what you have written, but also goes some way to paying for that new piece of equipment you have set your sights on.

Greenbank

Greenbank Electronics
(Dept T12C) 92 New Chester Road, New Ferry
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BARCLAYCARD welcome here

READ THIS IF YOU VALUE YOUR JOB

I am writing to a worried man (or woman). I am writing to you. Are you scared of computers? Well not scared of the computers themselves, but scared of what they can do. Pretty well everywhere at work, on TV, these micro-things are being seen more and more all the time and you seem more and more to be getting left behind.

Do you have colleagues who are always spouting on and on about computers? Do you understand a word of what they're saying? Be honest, do you? Do they understand a word of what they're saying really, or are they just speaking words they've read out of magazine or heard on T.V.?

What you need ot a friend, an honest friend, who will try to help you. I will be your friend, I am your friend. My name is Keith Parkins. Why not write to me or phone me (my number is 051-645 3391).

I said I would be an honest friend so I'll begin now – I work for a firm which sells a computer in kit form, and I would like to sell one to you. The name of the Computer System is the 'Custom 80 System'. I know you are going to buy a computer kit of some sort very soon, because you just can't let things go on as they are. 'Computing' is a club, and you're not a member yet. Worse stil? you may have bought a computer and found you still haven't a clue what goes on inside. Miracle chips they may be but it will be a miracle if you can understand what they do by just looking at them.

What I want to sell you is not just the pieces. I want to sell you 'the knowledge'. Then you'll know as much as I do, and you won't need me anymore. All I ask you is that when you know what computing is really all about, that you treat others in the same way that you would like to be treated. Don't sneer at them because they don't know the difference between PASCAL and BASIC, they don't know what an RS232C interface is, or how a UART works, remember we all had to start somewhere.

Computers are bound to make our lives easier and happier (and richer) if they are used wisely, so it is vital that everyone be introduced to the 'Computer club' as quickly as possible. Once everyone knows about computers we will be free to continue to make an honest living – at the moment there are all sorts of people who are unscroupulously taking money from innocent people by taking advantage of their ignorance, and I for one just don't want to be part of a business like that. Just read through a few advertisments, and think to yourself how can they **all** be the best.

When I said I am writing to sell you the knowledge please don't think I am offering a correspondence course. In my view that's not a suitable way to learn – a course has to proceed in simple logical steps – how an 'AND gate' works, and what is a 'flip-flop' and son on – microcomputers have left all that simple stuff behind long ago and you'll never catch up that way.

Learning computing is a bit like learning to swim, but you've got no time to waste. What I think you need is to be plunged in at the deep end – there's no time for splashing about in the paddling pool learning a bit at a time. But if you're going in at the deep end – you'll need a friend to save you from drowning – that's what I'm here for.

Of course it's not like swimming in one important respect – you have to buy a computer first before you can enter the water. Down at the shallow end this will cost you about £50 with a further £50 for the necessary RAN (memory), – at the deep end, where you'll find me, the cost is at least double.

I bet you're saying 'some friend this – he's already wanting me to spend twice as much as I thought!' Well it's true, I think you have got to, and here's why: The cheap systems are built down to price – the 'chip count' (number of integrated circuits used) has to be kept right down, preferably to four or five. There are two penalties to be paid. Firstly, no real expansion can be accommodated – the system will go so far then no further, secondly some special design 'tricks' have to be incorporated to make the chips do double duty and get the maximum performance out of the minimum resources. Don't get me wrong – some of these tricks are brilliant but the whole point in you buying a computer is so you can get an understanding yourself, not simply looking at a lump of silican (integrated circuit) where all the skill is buried. Once the design is 'encapsulated' in a master integrated circuit there's no way you'll ever find out what's inside unless the designer chooses to tell you, and he's hardly likely to tell you – he might want to use the same idea in the MKII model next year!

Some people go into this with their 'eyes open' – but I think computing has come to a pretty poor state of affairs if you have to be prepared to throw away a hundred pounds or so on a system which cannot expand with you, but has to be replaced by the next model annually.

I would also say beware of committing the diametrica opposite mistake – a gimmick computer. This is one which is all things to all men. You name it, it's got it. This processor, that processor as an option. Level 1 expands to level 2 which has the optional what not interface which can easily be adapted for this or that.

Do you think the purchase of a computer is going to solve your problems?, of course not, learnir.g is hard work. My computer (the Custom 80 System) is ideal for your purposes. I assume that you don't really know much about computers, you've probably got an interest in electronics, and with all the publicity that these micro chips are getting on magazines, TV, radio and newspapers you know that you've got to get to know all about them. Well I'll let you into a secret and give you some valuable information. There's too much going on for you to learn everything and new information is being created every day at such a rate that the longer you leave it to get started, the harder it will be to catch up.

Ask almost anyone what makes a good computer and they'll describe a monster. I'll show you the way to obtain sufficient knowledge to use computers for your pleasure, your work, and so that you can, if you want to, help others. It's all very well having a computer that has everything, but if you have too much hardware you'll be like the old woman who lived in the shoe, – you won't know what to do.

I have a friend who has bought a Custom 80 System, (I say he's a friend but at the moment he thinks he's just a customer) and he's received a parcel, he's opened it and checked that he's got what we think we have sent him and I imagine he's ploughing his way theough the manuals (yes one of the problems of being presented with a lot of information is having to read it all – carefully). He's got a lot of work ahead of him although he doesn't understand what it's all about, he'll learn from reading the manuals how to assemble the computer from. Its component parts, and then how to make it work.

I've put a lot of time and effort into this friendship, writing the words, and drawing what I think are helpful diagrams. I'm sure my friend will write to me with his problems and I'm also sure he will be delighted with his computer and any helpful remarks I may make.

I admit some of my answers to his problems may take the form of 'application notes', in fact most of them will, but that's just the way that I cope with helping lots of friends (when I get a letter with a problem or misunderstanding of something I've put in the manual, I write my answer in the form of an application note, then if I'm presented with the same problem again I can quickly give a well thought out answer in an application not with maybe just a covering letter).

If you've got a problem at the moment, you've either got a computer and not been able to learn all you need to know, or you haven't got one yet. Don't just go out and buy the first computer you see, or the biggest or the cheapest, buy the one that will help you to solve your problems. Remember that I'm here to help you, I've got a leaflet/data sheet set, that will probably tell you everything you need to know about my Custom 80 System. Write to me at Greenbank Electronics, using the above address and ask me to send you my Custom 80 leaflet. Now I warn you, there's quite a lot that I'll send you (about 20 sides of A4 for the data and introductory letter). It's type written with some hand drawn illustrations of the various kits. Of course it cost's quite a bit to send through the post so an A4 SAE would be appreciated but as you are my friends, if you don't enclose on I won't mind. By the way I'll probably enclose leaflets on some of the other things that my company sells but as I say to people I speak to, 'If I give you a leaflet you don't want please don't be offended'.

I'm being honest with you, I'm trying to make you into a Custom 80 user, because the more people who have this system, the more people I'll be able to exchange my programs with, and that's important.

You might not think that you are capable of building up a sophisticated computer system from component parts, but you need have no worries on that score. You do of course have to work carefully and patiently, but that's all you have to do. I haven't met anyone yet who was incapable of doing the job. Some people need a bit of help, some people need more help than others, but the way I look at it is that if you can't follow the instructions I have provided then it's my fault not yours. The same applies to testing the completed computer. If you make a board and you can't get it to work. I am here to help you – just pop the board into the post to me, ans I'll plug it into my own system and will soon get it going for you.

Even if you don't buy the Custom 80 System then I do urge you to buy some sort of computer as soon as you can. If you have any children this is even more important. Children need computers almost as much as they need food and drink. There never was a more nutritious food for a young mind than a digital computer. Without a preconceived feeling that computers are somehow mystical, children are in a far better position to learn than we mere adults.

So far I have only let you think that the Custom 80 System will cost you money, but there are plenty of ways it will bring money in. Obviously if you have your own business you will know how much time and money a computer will save. And if you have brought yourself up to a standard where you can write your own programs and fix the system yourself (not that it will go wrong, you built if – remember) there won't be any hidden overheads to be paid. Other ways you can make money are writing programs that you can sell, or even writing a book. Don't think that you have to be particularly clever to do this. There may be thousands of people less fortunate than you who will be dying to hear of another's experiences. The last thing they will want will be some high faluting to me written by some lah-di-dah computer boffin.

I look forward to hearing from you so I can tell you about my Custom 80 Computer.

These cut prices for Amateur Users and Export
Note industrial users quantity prices available
Mostly Motorola, RCA

CMOS

4000	14p	4042	60p	4093	43p	4409	£7.90	4530	70p
4001	14p	4043	70p	4094	£1.68	4410	£7.20	4531	£1.30
4002	14p	4044	65p	4095	90p	4411	£6.95	4532	£1.10
4006	66p	4045	£1.70	4096	90p	4412VP	£8.00	4534	£5.00
4007	18p	4046	75p	4097	£3.20	4415V	£4.80	4536	£2.95
4008	62p	4047	75p	4098	88p	4422	£5.66	4537L	£26.10
4009	35p	4048	55p	4099	95p	4433	£7.70	4538	£1.15
4010	40p	4049	50p	40100	£1.92	4435V	£5.40	4539	£1.15
4011	15p	4050	30p	40101	£1.30	4450	£3.50	4541	£1.19
4012	18p	4051	78p	40102	£1.80	4461	£3.93	4543	£1.35
4013	34p	4052	78p	40103	£1.75	4462	£4.41	4549	£3.95
4014	75p	4053	78p	40104	95p	4490PP	£3.50	4552	£14.85
4015	66p	4054	£1.25	40105	£1.15	4490VP	£3.14	4553	£2.99
4016	32p	4055	£1.25	40106	75p	4500	£6.75	4554	£1.38
4017	48p	4056	£1.20	40107	60p	4501	29p	4555	50p
4018	68p	4059	£4.80	40108	£4.50	4502	£1.20	4556	55p
4019	42p	4060	90p	40109	£1.00	4503	70p	4557	£3.20
4020	61p	4062	£9.95	40110	£3.00	4505	£5.71	4558	£1.20
4021	70p	4063	99p	40114	£1.77	4506	50p	4559	£3.95
4022	66p	4066	36p	40160	£1.54	4507	40p	4560	£1.80
4023	20p	4067	£3.99	40161	£1.54	4508	£2.65	4561	81p
4024	45p	4068	22p	40162	£1.54	4510	68p	4562	£4.95
4025	19p	4069	20p	40163	£1.54	4511	68p	4566	£1.59
4026	£1.30	4070	26p	40174	£1.54	4512	75p	4568	£2.38
4027	38p	4071	20p	40181	£5.03	4513	£1.99	4569	£1.75
4028	58p	4072	20p	40182	£1.90	4514	£1.95	4572	36p
4029	77p	4073	20p	40192	£2.41	4515	£1.98	4580	£4.60
4030	50p	4075	20p	40193	£2.41	4516	75p	4581	£2.50
4031	£1.70	4076	60p	40194	£1.05	4517	£4.15	4582	99p
4032	£1.25	4077	26p	40208	£7.54	4518	42p	4583	90p
4033	£1.65	4078	26p	40257	£2.31	4519	29p	4584	48p
4034	£1.95	4081	26p	4160	95p	4529	78p	4597	£2.44
4035	95p	4082	26p	4161	99p	4521	£2.00	4598	£2.90
4037	£1.15	4085	21p	4162	99p	4522	£1.11	4599	£5.95
4038	£1.10	4085	65p	4163	99p	4526	95p	4700	£1.75
4039	£2.79	4086	65p	4174	99p	4527	£1.15	ICM7038A	
4040	59p	4086	70p	4175	£1.05	4528	80p		£4.25
4041	78p	4089	£1.40	4194	£1.05	4529	£1.30		

74C

		74C76	57p	74C163	£1.15	74C904	57p	74C926	£5.99
		74C83	£1.34	74C164	£1.60	74C905	£7'53	74C927	£5.99
		74C85	£1.34	74C165	£1.08	74C905	57p	74C928	£5.99
74C00	28p	74C88	67p	74C173	93p	74C907	57p	74C929	£17.90
74C02	28p	74C89	£4.62	74C174	93p	74C908	£1.00	74C930	£17.90
74C04	28p	74C90	89p	74C175	93p	74C909	£1.69		
74C08	28p	74C93	90p	74C192	£1.15	74C909	£1.69		
74C10	28p	74C99	£1.06	74C193	£1.15	74C910	£7.45	80C95	85p
74C14	30p	74C107	£1.27	74C195	£1.00	74C911	£7.39	80C96	92p
74C20	28p	74C150	£3.81	74C200	£7.45	74C912	£7.39	80C97	85p
74C30	28p	74C151	£2.55	74C221	£1.41	74C914	£1.45	80C98	92p
74C32	28p	74C154	£3.81	74C373	£1.79	74C915	£1.15	82C19	£6.20
74C42	95p	74C157	£2.29	74C374	£1.79	74C918	£1.10	88C29	£2.90
74C48	£1.43	74C160	£1.40	74C901	57p	74C921	£17.07	88C30	£2.90
74C73	57p	74C161	£1.15	74C902	79p	74C922	£3.78		
74C74	50p	74C162	£1.15	74C903	57p	74C923	£5.49		
						74C925	£5.99		

74LS

		74LS55	30p	74LS151	39p	74LS243	85p	74LS367	37p
		74LS63	£1.50	74LS153	39p	74LS244	80p	74LS368	66p
74LS00	12p	74LS73	25p	74LS154	£1.70	74LS245	£1.18	74LS373	75p
74LS01	13p	74LS74	25p	74LS155	39p	74LS247	40p	74LS374	75p
74LS02	14p	74LS75	28p	74LS156	39p	74LS248	65p	74LS375	48p
74LS03	14p	75LS76	20p	74LS157	35p	74LS249	68p	74LS377	90p
74LS04	15p	74LS78	24p	74LS158	36p	74LS251	40p	74LS378	69p
74LS05	15p	74LS83	50p	74LS160	41p	74LS153	40p	74L379	65p
74LS08	15p	74LS85	70p	74LS161	41p	74LS257	48p	74LS384	86p
74LS09	15p	74LS86	38p	74LS162	41p	74LS258	40p	74LS386	86p
74LS10	15p	74LS90	35p	74LS163	41p	74LS259	85p	74LS390	62p
74LS11	15p	74LS91	80p	74LS164	48p	74LS260	27p	74LS393	60p
74LS12	15p	74LS92	36p	74LS165	75p	74LS261	£1.95	74LS395	£1.99
74LS13	30p	74LS93	36p	74LS166	85p	74LS266	25p	74LS396	£1.90
74LS14	48p	74LS95	45p	74LS170	£1.70	74LS273	90p	74LS398	£2.75
74LS15	15p	74LS96	£1.16	74LS170	72p	74LS275	£2.50	74LS399	£2.20
74LS20	15p	74LS107	43p	74LS174	72p	74LS279	88p	74LS445	£1.40
74LS21	15p	74LS109	30p	74LS175	58p	74LS283	45p	74LS447	£1.44
74LS26	18p	74LS112	30p	74LS181	£1.30	74LS290	57p	74LS490	£1.80
74LS27	15p	74LS113	40p	74LS183	£2.75	74LS293	46p	74LS668	£1.75
74LS28	20p	74LS114	35p	74LS190	58p	74LS295	£2.15	74LS669	£1.50
74LS30	18p	74LS122	44p	74LS191	58p	74LS298	£1.30	74LS670	£1.75
74LS32	15p	74LS123	55p	74LS192	58p	74LS324	£2.00		
74LS33	16p	74LS124	£1.05	74LS193	65p	74LS325	£2.90		
74LS37	16p	74LS125	30p	74LS194	40p	74LS326	£2.90		
74LS38	16p	74LS126	30p	74LS194	40p	74LS326	£2.94		
74LS40	16p	74LS132	45p	74LS195	40p	74LS327	£2.86		
74LS42	35p	74LS136	28p	74LS196	58p	74LS347	£1.48		
74LS47	40p	74LS138	35p	74LS197	85p	74LS348	£1.86		
74LS48	80p	74LS139	38p	74LS221	60p	74LS352	£1.85		
74LS49	60p	74LS145	75p	74LS240	96p	74LS353	£1.85		
74LS51	15p	74LS147	£1.70	74LS241	96p	74LS365	37p		
74LS54	15p	74LS148	99p	74LS242	85p	74LS366	37p		

74S

74S04	73p

QUARTZ

32 768KHz (watch	£2.50
60 KHz	£9.95
100 0 KHz	£2.90
200 0 KHz	£3.70
204 8 KHz	£3.92
262 144 KHz	£3.92
307 2 KHz	£3.92
312 5 KHz	£3.92
455 0 KHz	£3.83
1 000 MHz	£2.95
1 008 MHz	£3.50
1 280 MHz	£3.92
1 6 MHz	£3.23
1 8 MHz	£3.23
1 8432 MHz	£2.99
2 000 MHz	£2.80
2 097152 MHz	£3.23
2 4576 MHz	£2.99
2 500 MHz	£3.92
2 56250 MHz	£3.62
3 000 MHz	£3.62
3 2768 MHz	£2.70
3 579545 MHz	£1.75
3 93216 MHz	£3.92
4 000 MHz	£1.99
4 032 MHz	£1.99
4 096 MHz	£1.99
4 194304 MHz	£1.99
4 433619 MHz	£1.25
4 608 MHz	£3.23
4 800 MHz	£1.99
4 9152 MHz	£3.23
5 000 MHz	£1.99
5 0688 MHz	£2.70
5 120 MHz	£3.23
5 185 MHz	£3.23
5 24288 MHz	£4.25
6 000 MHz	£2.70
6 144 MHz	£2.70
6 400 MHz	£3.23
6 55360 MHz	£1.99
7 000 MHz	£1.99
7 168 MHz	£2.50
7 680 MHz	£1.99
7 86432 MHz	£3.23
8 000 MHz	£1.99
8 08333 MHz	£3.62
8 388608 MHz	£3.23
8 867237 MHz	£2.99
9 375 MHz	£3.23
10 000 MHz	£1.99
10 245 MHz	£3.23
10 700 MHz	£3.23
10 92 MHz	£3.92
11 000 MHz	£3.92
12 000 MHz	£3.50
14 0 MHz	£3.92
14 31818 MHz	£3.62
16 000 MHz	£2.90
18 000 MHz	£2.50
18 432 MHz	£2.90
19 968 MHz	£3.00
20 000 MHz	£2.80
20 1134 MHz	£3.23
24 0 MHz	£3.92
26 690 MHz	£2.90
27 0 MHz	£3.92
27 145 MHz	£3.00
27 648 MHz	£3.23
38 6666 MHz	£3.50
48 000 MHz	£2.70
100 000 MHz	£2.90
116 000 MHz	£3.00

VEROBOARD

0.1" Pitch with copper strips

2½" × 1" (pack of 5)	£1.01
2½" × 3¾"	73p
2½" × 5"	83p
2½" × 17"	£2.51
3¾" × 3¾"	83p
3¾" × 5"	95p
3¾" × 17"	£3.26
4 7" × 17 9"	£4.26

0.1" Plainboard (no strips)

3¾" × 2½"	52p
3¾" × 5"	79p
3¾" × 17 0"	£2.11
Terminal pins	£1.50 500
V Q DIP board	£1.58
DIP breadboard	£3.59
Spot face cutter	£1.18
Pin insertion tool	£1.62

SOLDERCON PINS

100 60p
500 £2.75 1000 £4.95

DIL SOCKETS

8/14/16 pin 10p/12p/13p
18/20/22 pin 18p/20p/25p
24/28/40 pin 30p/40p/50p
24 pin Textool lever type zero insertion force £6.50

EDGE CONNECTORS

43 way 0.1" pitch wire wrap polarizing slot pin 37
Single sided (1 × 42) £3.11
Double sided (2 × 42) £4.10

TIMER ICs

555/556 16p/49p

OP-AMPS

(All Mini dips)

CA 3130E	84p
CA 3140E	35p
741	14p

LED DISPLAYS

DL 704E	99p
DL 727E/728E	£2.00
DL 747E/750E	£1.80
FND 500/560	£1.20

LIQUID CRYSTAL DISPLAY

4 × 0.5" Digits 40 pin DIL £9.75

CLOCK CHIPS

AY-5-1224A	£2.60
MK 50253	£5.50
MK 50366	£6.50

SIX DECADE COUNTERS

MK 50395/6/7	£9.90
50399	£7.50

SWITCH MODE PSUs



AC 5221S 5V 10A	£69.90
AC 5421S 5V 20A	£99.20
AC 9421S 5V 10A 12V 2A 12V 2A 5V 0 1A	£126.50

OPEN CARD SWITCH MODE PSU

FULLY ASSEMBLED P.C.B. CARD 197 × 108 × 52mm Outputs +5V/6A, 5V/0 5A, +12V/1A, 12V/1A Type AC9251 **£61.75**
AC8353 5V/3A, 24V/3A, 12V/0 17A, 187 × 157 × 52mm **£69.50**

MICROPROCESSORS

6502

6502	£4.95
6520/21	£3.25
6522	£4.95
6532	£7.95

Z80

Z80A CPU	£5.50
Z80A P10	£4.40
Z80A CTC	£4.40
Z80A S10/10	£23.00

6800

6800 MPU	£3.75
6802 MPU	£5.50
6809	£13.95
6810 (128 × 8 RAM)	£3.25
68A10 (128 × 8 RAM)	£3.75
6820, 6821 P1A	£1.75
6845	£9.75
6850 ACIA	£1.75
MC6880	£1.50

SC MP II RAM I O

SC MP II (4MHz)	£12.00
INS 8154 RAM I O	£9.40
INS 8255 I O	£3.50

CMOS

COSMAC CDP 1802CE	£6.50
COSMAC CDP 1802E	£10.85
CDP 1864	£6.45

STATICS (Mostly 450nS)

2112 256 × 4	£2.25
2114 1K × 4	99p
8 × 2114	£7.92
6116 CMOS 2K RAM 200 nS	£10.99
4118 1K × 8	£3.95

DYNAMICS

4116 16K 200nS	87p
8 × 4116	£6.88

UV ERASABLES

5204 (512 × 8)	£7.95
2708 1K × 8	£1.73
2716 2516 2K × 8 single 5v	£2.30
2532 4K × 8 (5v)	£5.95

PROM WASHING SERVICE

50p each prom

SPARE ERASER TUBE

U-V tube (12") £10.00

UV PROM ERASER

UV140	£61.20
UV141	£77.70
EPROMPT	£33.00

INTERFACE

81LS95	90p
81LS96 7	99p
81LS98	£1.40
1488 (RS232)	75p
75491 LED driver	50p
75492	92p
8T26 8T28	£1.50
IL74	48p
AY-3-8910	£5.95
FD 1771	£24.00
8131	£2.59
8136	£2.59
ICM 7209 IPA	£2.69

CRT CONTROLLER Uarts

AY-5-1013	£3.50
AY-5-1013A	£4.70
AY-3-1014A	£5.50
AY-3-1015	£3.95
6402	£3.80
1402	£4.50

CHAB GEN KEYBOARD ENCODER

MK 2302	£15.29
RO 3 2513 (5v Uppercase)	£4.75
AY 5 2376	£5.99

FIRMWARE

2K ZYMON for Z80 (1 × 2516) includes commented listing	£14.95
1K ZMON Z80 (1 × 2516 or 1 × 2708)	£14.95
2K Tiny Basic for Z80 (1 × 2516)	£14.95
4K NIBL for SC MP (4 × 2708)	£49.95
4K NIBL-MM for SC MP (4 × 2708)	£49.95
(Description leaflet available)	
1K Elektor Junior (1 × 2708)	£19.85
1½K ELBUG (3 × 5204)	£35.00
ETIBUG (1 × 5204)	£35.00
ETIBUG (1 × 5204)	£14.95
ETIBUG 2 (1 × 5204)	£14.95
SCMP KB (1 × 5204)	£14.95

NUMBER CRUNCHER

MM57109 £12.48

UHF MODULATORS

UM1111 E36 Vision modulator. TV game or cheap computer type **£2.80**
UM1231 E36 Wide bandwidth, computer VDU type, pos neg transfer characteristic **£4.95**
UM1233 E36 Wide bandwidth, computer VDU type **£4.50**
UM1286 E36 Combined wide bandwidth vision modulator with intercarrier sound, high performance **£8.25**

VOLTAGE REGULATORS

7805	50p
7905	55p
7812	50p
7912	55p

VOLTAGE CONVERTER MODULES

Ideal for use in otherwise 5V only systems, to obtain +12V, 12V or dual 12V power for ASCII keyboards, RS 232 Interfaces, dynamic RAMs, etc. All types need +5V input. Size of each module (excluding pins) 34 × 26 × 10mm

Type ADIP-12A10
+12V output (25-84mA) **£4.95**
Type ADIN-12A10
12V output (25-84mA) **£4.95**
Type ADID-12A10
± 12V dual output, 2 × (12 42mA) £5.25

T.V. MONITOR P.C.B. for DEM users

This is an assembled P.C.B. size 130 x 190mm, which you add to your own 12" 14" black and white C.R.T. (90 degree 20mm dia. neck), to obtain a T.V. monitor at model cost. (Regrettably we cannot supply the C.R.T. at present).
Prestel controls contrast brighteness, etc. are included and the only inputs needed are 15 Volts 10 AC at 1.5 Amps and 1 Volt PK.GK. composite video input.
Supplied with Circuit diagram £33.50

KEYBOARD CASES

405 x 210mm. Panel size 330 x 188mm	£10.14
510 x 340mm. Panel size 430 x 115mm	£26.22

EUROCARD 19" CARD FRAME

Kit of 2 end plates + angles, 2 front and 2 rear tie bars, 4 guide location strips **£28.84**

Accessories

Card guides (pack of 10)	£1.53
Connector mounting strips (pair)	£3.27
Case conversion kit	£19.80
(or fit into separate 3U 19" D type case)	£32.58

DIN 41612 Eurocard Connectors

64 way Plug rows a + c (64/96)	£2.22
64 way Socket rows a + c (64/96)	£3.39
64 way Plug rows a + b (64/64)	£2.71
64 way Socket rows a + b (64/64)	£4.24

MICROCOMPUTER COMPONENTS

LOWEST PRICES – FASTEST DELIVERY

Device	Price
MEMORIES	
2114L-200ns	1+1.28
	25+1.19
2114L-300ns	1+1.28
	25+1.19
2708 450ns	1.99
2716 450ns	1+2.49
	25+2.37
2716 350ns	6.95
2532 450ns	1+5.50
	25+5.31
2732 450ns	1+4.80
	25+4.08
4116 150ns	1+1.15
	25+1.06
4116 200ns	1+0.80
	25+0.72
6116 200ns	10.95
4118 200ns	3.90
8264 200ns	12.00
5516 200ns	22.88
CRT CONTROLLERS AND GRAPHIC DISPLAY PROCESSORS	
EF9364	5.94
EF9365	62.90
EF9366	62.90
BUFFERS	
81LS95	0.90
81LS96	0.90
81LS97	0.90
81LS98	0.90
8T26A	1.50
8T28A	1.50
8T95	1.50
8T97A	1.50
8T98	1.50
DATA CONVERTERS	
ZN425E-8	3.50
ZN426E-8	3.00
ZN427E-8	6.28
ZN428E-8	4.78
ZN429E-8	2.10
ZN432CJ-10	28.09
ZN433CJ-10	22.59
ZN440	56.63
MISCELLANEOUS	
AY-3-1015	3.90
AY-5-1013	3.45
AY-5-2376	6.95
MC1488	0.64
MC1489	0.64
MC14411	6.94
MC14412	7.99
RO-3-2513L	7.70
RO-3-2513U	7.70
ZN450E	7.61
7805	0.50
7812	0.50
7905	0.55
7912	0.55
ZILOG Z80 FAMILY	
Z80 CPU	4.00
Z80A CPU	4.82
Z80 CTC	4.00
Z80A CTC	4.00
Z80 DART	7.18
Z80A DART	7.18
Z80 DMA	11.52
Z80A DMA	9.99
Z80 PIO	3.78
Z80A PIO	3.78
Z80 SIO-0	13.95
Z80A SIO-0	13.95
Z80 SIO-1	13.95
Z80A SIO-1	13.95
Z80 SIO-2	13.95
Z80A SIO-2	13.95
EFCIS 6800 FAMILY	
EF6800	3.70
EF6802	5.11
EF6803	11.80
EF6809	11.95
EF6810	1.35
EF6821	1.74
EF6840	4.20
EF6845	9.50
EF6850	1.70
EF6862	6.91
EF6871-A1T	18.70
EF6880	1.07
EF6887	0.80
EF68488	9.11
EF6875	4.18
6502 FAMILY	
SYP6502	4.95
SYP6520	3.15
SYP6522	4.95
SYP6532	7.95
8080 FAMILY	
8085A	5.50
8212	1.70
8216	1.70
8224	2.45
8228	3.95
8251	3.95
8253	7.95
8255	3.95
CMOS 4000 'B' SERIES	
4000	0.12
4001	0.13
4002	0.13
4006	0.60
4007	0.17
4008	0.55
4009	0.28
4010	0.28
4011	0.14
4012	0.17
4013	0.33
4014	0.58
4015	0.58
4016	0.28
4017	0.45
4018	0.58
4019	0.29
4020	0.58
4021	0.60
4022	0.62
4023	0.17
4024	0.38
4025	0.16
4026	0.99
4027	0.30
4028	0.55
4031	1.65
4033	1.60
4034	1.55
4035	0.72
4040	0.57
4041	0.69
4042	0.54
4043	0.59
4044	0.64
4045	1.65
4046	0.68
4047	0.68
4048	0.54
4049	0.30
4050	0.30
4051	0.59
4052	0.68
4053	0.59
4054	1.20
4055	1.20
4060	0.89
4063	0.95
4066	0.34
4068	0.17
4069	0.17
4070	0.19
4071	0.19
4072	0.19
4073	0.19
4075	0.17
4076	0.60
4077	0.22
4078	0.24
4081	0.14
4082	0.19
4085	0.63
4086	0.69
4093	0.39
4502	0.69
4507	0.39
4508	1.90
4510	0.60
4511	0.49
4512	0.60
4514	1.49
4515	1.49
4516	0.75
4518	0.40
4519	0.28
4520	0.69
4521	1.49
4522	1.20
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74LS156	0.38
74LS157	0.34
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74LS161	0.39
74LS162	0.39
74LS163	0.39
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74LS175	0.54
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74LS191	0.55
74LS192	0.69
74LS193	0.59
74LS194	0.39
74LS195	0.39
74LS196	0.58
74LS197	0.65
74LS221	0.60
74LS240	0.89
74LS241	0.89
74LS242	0.79
74LS243	0.79
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74LS245	0.89
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74LS253	0.39
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74LS259	0.38
74LS261	1.90
74LS266	0.23
74LS273	0.90
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74LS283	0.44
74LS290	0.56
74LS293	0.45
74LS365	0.34
74LS366	0.34
74LS367	0.34
74LS368	0.34
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Don Scales

Can you remember which card matches yours or will the computer get there first?



This program is based on the children's game of the same name (sometimes called pairs). The player is competing against the computer, the object of the game being to match pairs of cards, and the winner is the one who has the most pairs at the end of the game.

Initially, the machine randomly shuffles a pack of 25 pairs of cards and displays them, face down, on the screen. The cards are numbered 1 to 50. Each player (you and the machine) turns over two cards in an attempt to produce a match. If unsuccessful, the cards are turned back and the next player has a turn. If successful, the cards are removed and another turn is allowed. The game continues until all the cards are removed.

To make the game fair, the machine is programmed to use an open end stack. The length of the machine's memory (the stack) depends on the degree of difficulty, and increases by a power of two for each level. Level one only remembers the last two cards, level six will not forget any. After a few games, players should occasionally beat the machine on level three. Players with photographic memories or masochistic tendencies should try level six. The program is written for a Triton with the Level 7 BASIC but the programming has been kept simple to enable easy conversion to other machines.

Program Notes

The following description should explain the program and help with any conversion.

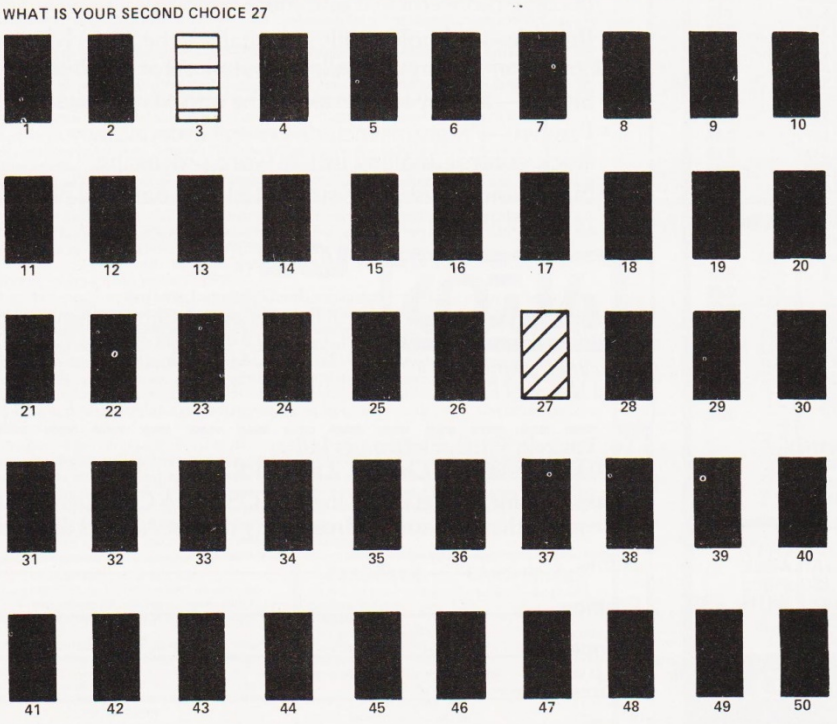
100-170 The program uses two arrays, A for the cards and M for the memory. RANDOMIZE re-seeds the random number generator. DL is the delay time for displaying a card and should be adjusted to taste. R and S are the scores.

1000-1060 CLS clears the screen. The PRINT statements produce the title.

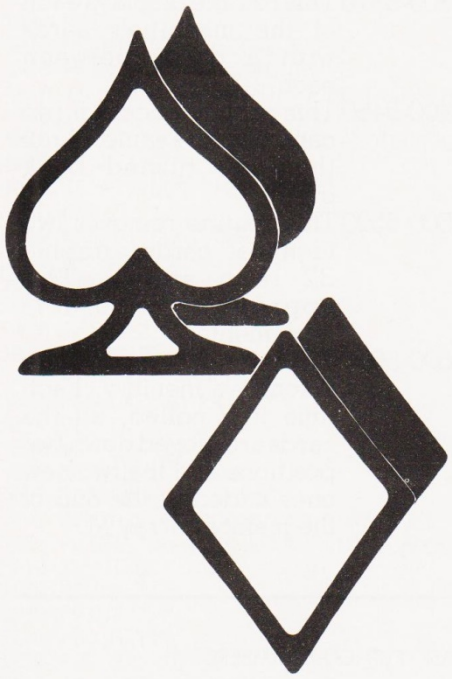
1100-1140 The degree of difficulty is read into I and converted into a power of two in T. T is then used for the length of memory M.

1200-1310 The display of the Triton is 64 characters wide by 16 lines deep. The top line of the display is used for communication. Each card is made up of six graphic characters and is three characters wide by two deep. To number under the cards, the program first spaces down the top line and then loops five times to write five rows of numbers.
For each row of cards two lines are spaced and the numbers written on the third.
The complicated PRINT statement is just to get the number under the card. SPC prints spaces and the first part of the PRINT spaces two or one spaces for one or two digit numbers, the semicolon causes one space followed by the one or two digit numbers, then the next semicolon and SPC results in two more spaces, the last semicolon keeps the print on the same line with no space. All this to print six characters with the number in the middle!

1320-1330 VDU is a special Triton command. VDU 0,28 resets the cursor to the top of the screen without clearing it. The FOR...NEXT loop is a time delay to wait for this to happen.



The first move of the game. The player first selected card 3 and then tried card 27. There is no match so play will pass to the computer.



1400-1460 This part shuffles the cards. The array A is initialled with 1,1,2,2,3,3 etc up to 25,25 and then randomly shuffled. The SWAP statement just swaps over the contents of the two arguments.
The numbers stored in the array A are used to select the graphic symbol. By changing the initialisation, graphic characters can be chosen accordingly.

1500-1530 Initially all the cards are placed face down. Y is used to carry the value of the graphic for display. Graphic 122 on the Triton is a negative blank and is used for the back of the card. X is the card number to display. All 50 cards are displayed face down.

2000-2050 2000 is the start of the main program loop. The player always has first turn and routines are used to ask for and display two cards. B and C are used to contain the card numbers chosen. A check is made to prevent duplication. Statement 2050 delays the program while the second card is studied.

2060-2090 A routine is called to check for a match and to turn back the cards. A check for completion is made and another go given if a successful match was made.

2100 The machine memory routine is called here to remember the two cards played.

2200-2310 The start of the machine's go. Here the machine scans its memory for a pair.

2400-2480 If no pair is found, a card not in its memory is chosen. A zero card value means it has already been taken. Once a card is chosen, the machine scans its memory again for a match.

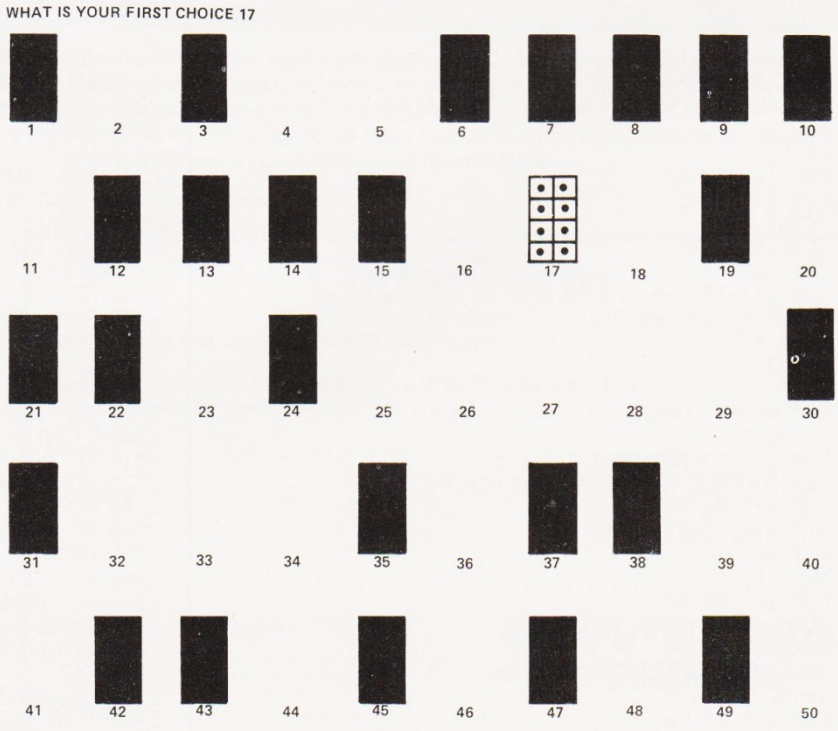
2500-2560 If still no pair has been found, a second card not in its memory is chosen. Having already chosen its first card, the machine is only allowed to compare the two chosen cards.

2600 If the two chosen cards are not a match, the memory routine is called again.

2700-2740 The machine has now made its selection and they are displayed, checked and then turned back or removed. If all the cards have now been taken the game ends, if the machine has found a pair it gets another go.

4000-4080 This part is executed at the end of a game to display the scores and make the appropriate comments.

5000-5095 This routine displays a card. Y contains the required graphic and X the card number.
The routine calculates the top left-hand index of a card. The calculations have been kept simple to aid modification. I ends up holding the row number and J the column. K is the top left-hand index (between 1 and 2024 on the Triton screen). VDU is used here again, in this mode it allows memory mapping into the screen RAM. The first argument is the position and the second the required graphic. The FOR . . . NEXT loop maps



A typical display with the game about half-way through. The player has just selected card 17 as his first choice and the program has revealed it.

a card three characters wide and two characters high.

5100-5240 This routine asks for a card and displays it. Only the top line is available for communication so great care is taken to prevent the other lines being overwritten. A PRINT statement asks for the choice leaving the cursor on the same line. The reply is INPUT as a character so that any INPUT is accepted. Again the VDU command is used, VDU 0,11 spaces the cursor up one line (to the top of the screen again). The message is then blanked and the cursor spaced to the top of the screen. This is done so that the player sees when a message is printed. The FOR...NEXT loop is used to check the players' input is between 1 and 50. The comparison is done by converting C to characters, if a match is found the loop is exited with the integer value in C. If no match is found the message is repeated. If the card has already been taken the message is again repeated. Otherwise the position and graphic are extracted and the card displayed.

5300-5370 This routine displays each of the machine's cards with a delay between each.

5400-5460 This routine checks if two cards are the same. If not they are turned back over.

5500-5590 This routine removes two identical cards, graphic 32 is a space. The appropriate score is incremented.

5600-5670 This routine is the machine's memory. Each time it is called, all the cards are moved down two positions and the two new ones added at the end of the memory array M.

Program Listing

```
  99 REM DEFINE VARIABLES AND ARRAYS
 100 DIM A(50)
 110 DIM M(50)
 120 RANDOMIZE
 150 DL=1000
 160 R=0
 170 S=0
 999 REM CLEAR SCREEN:PRINT TITLE
1000 CLS
1010 PRINT:PRINT:PRINT
1020 PRINT TAB(20),"PELMANISM"
1030 PRINT TAB(20),"*********"
1040 PRINT:PRINT:PRINT
1050 PRINT " A GAME TO TEST YOUR MEMORY"
1060 PRINT
1099 REM ESTABLISH DEGREE OF DIFFICULTY
1100 INPUT "ENTER DEGREE OF DIFFICULTY 1-6";I
1110 IF I<1 OR I>6 THEN 1100
1120 T=1
1130 FOR J=1 TO I:T=T*2:NEXT J
1140 IF T>50 T=50
1199 REM CLEAR SCREEN:NUMBER UNDER CARDS
1200 CLS
1210 PRINT
1220 FOR I=0 TO 4
1230 FOR J=1 TO 2
1240 PRINT
1250 NEXT J
1260 J=I*10+1
1270 FOR J=J TO J+9
1280 PRINT SPC(3-LEN(STR(J)));J;SPC(1);
1290 NEXT J
1300 PRINT
1310 NEXT I
1319 REM RESET CURSOR TO TOP OF SCREEN
1320 VDU 0,28
1330 FOR I=1 TO 300:NEXT I
1399 REM SHUFFLE 25 PAIRS:ZERO MEMORY
1400 FOR I=1 TO 50
1410 A(I)=INT(I/2+.5)
1420 M(I)=0
1430 NEXT I
1440 FOR I=1 TO 50
1450 SWAP A(I),A(RND(1)*50+1)
1460 NEXT I
1499 REM DISPLAY CARDS FACE DOWN
1500 Y=122
1510 FOR X=1 TO 50
1520 GOSUB 5000
1530 NEXT X
1999 REM MAIN LOOP:ASK FOR CARD NUMBERS
2000 N="1ST"
2010 GOSUB 5100
2020 B=C
2030 N="2ND"
2040 GOSUB 5100
2045 IF B=C THEN 2030
2050 FOR I=1 TO DL:NEXT I
2060 Z=1
2070 GOSUB 5400
2080 IF R+S=25 THEN 4000
2090 IF Z=0 THEN 2000
2099 REM REMEMBER CARDS JUST PLAYED
2100 GOSUB 5600
2199 REM SCAN MEMORY FOR PAIRS
2200 FOR I=1 TO T-1
2210 B=M(I)
2220 IF B=0 THEN 2310
2230 IF A(B)=0 THEN 2310
2240 FOR J=I+1 TO T
2250 C=M(J)
2260 IF C=0 THEN 2300
2270 IF B=C THEN 2300
2280 IF A(C)=0 THEN 2300
2290 IF A(B)=A(C) THEN 2700
2300 NEXT J
2310 NEXT I
2399 REM SELECT 1ST RANDOM CARD
2400 B=INT(RND(1)*50+1)
2410 IF A(B)=0 THEN 2400
2420 FOR I=1 TO T
2430 IF M(I)=B THEN 2400
2440 NEXT I
2450 FOR I=1 TO T
2460 C=M(I)
2470 IF A(B)=A(C) THEN 2700
2480 NEXT I
2499 REM SELECT 2ND RANDOM CARD
2500 C=INT(RND(1)*50+1)
2510 IF B=C THEN 2500
2520 IF A(C)=0 THEN 2500
2530 FOR I=1 TO T
2540 IF M(I)=C THEN 2500
2550 NEXT I
2560 IF A(B)=A(C) THEN 2700
2599 REM REMEMBER THE CARDS
2600 GOSUB 5600
2699 REM COMPARE MACHINE PICKS
2700 Z=2
2710 GOSUB 5300
2720 IF R+S=25 THEN 4000
2730 IF Z=0 THEN 2200
2740 GOTO 2000
```

```
3999 REM END OF GAME:PRINT SCORES
4000 CLS
4010 PRINT "YOUR SCORE IS",R
4020 PRINT " MY  SCORE IS",S
4030 IF S>R THEN PRINT "I HAVE WON ANOTHER GAME"
4040 IF R>S THEN PRINT "YOU HAVE WON THIS TIME - JUST"
4050 INPUT "WOULD YOU LIKE ANOTHER GAME ?";A
4060 IF A="YES" THEN 150
4070 IF A<>"NO" THEN 4050
4080 END
4999 REM DISPLAY CARD PATTERN Y
5000 J=X-1
5010 I=INT(J/10)
5020 J=J-I*10
5030 I=I*3+2
5040 J=J*6+2
5050 K=J+(I-1)*64
5060 FOR L=K TO K+2
5070 VDU L,Y
5080 VDU L+64,Y
5090 NEXT L
5095 RETURN
5099 REM ASK FOR CARD AND TURN OVER
5100 PRINT "WHAT IS YOUR ";N;" CHOICE ";
5110 INPUT C
5120 VDU 0,11
5130 PRINT " "
5140 VDU 0,11
5150 FOR C=1 TO 50
5160 IF C=STR(C) THEN 5200
5170 NEXT C
5180 GOTO 5100
5200 IF A(C)=0 THEN 5100
5210 X=C
5220 Y=A(C)
5230 GOSUB 5000
5240 RETURN
5299 REM DISPLAY MACHINE CHOISE:DELAY
5300 X=B
5310 Y=A(B)
5320 GOSUB 5000
5330 FOR I=1 TO DL:NEXT I
5340 X=C
5350 Y=A(C)
5360 GOSUB 5000
5370 FOR I=1 TO DL:NEXT I
5399 REM COMPARE CARDS:TURN BACK
5400 IF A(B)=A(C) THEN 5500
5410 Y=122
5420 X=B
5430 GOSUB 5000
5440 X=C
5450 GOSUB 5000
5460 RETURN
5499 REM TWO IDENTICAL CARDS:REMOVE
5500 Y=32
5510 X=B
5520 A(B)=0
5530 GOSUB 5000
5540 X=C
5550 A(C)=0
5560 GOSUB 5000
5570 IF Z=1 THEN R=R+1
5580 IF Z=2 THEN S=S+1
5590 Z=0
5595 RETURN
5599 REM REMEMBER CARDS
5600 IF T<=2 THEN 5650
5610 FOR I=3 TO T
5620 M(I-2)=M(I)
5630 NEXT I
5650 M(T-1)=B
5660 M(T)=C
5670 RETURN
```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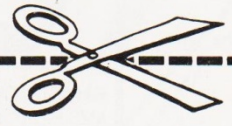

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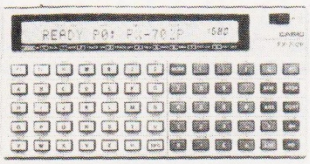

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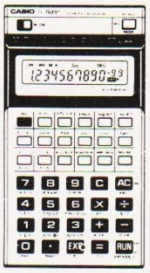

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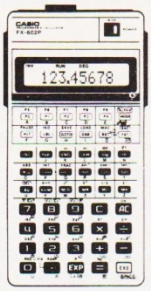

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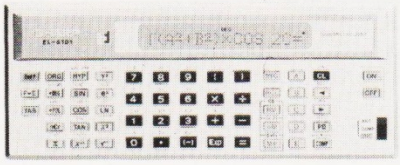

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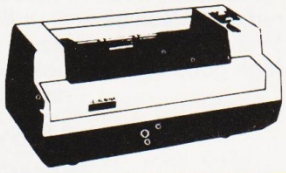

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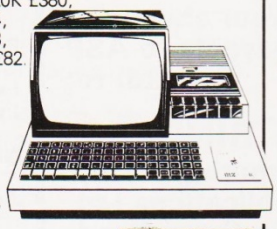

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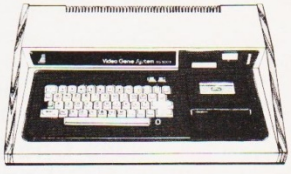

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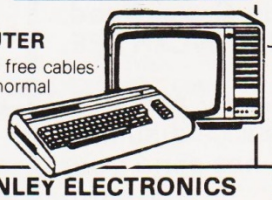

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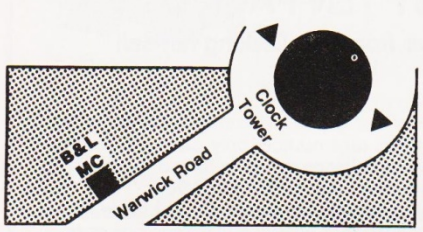

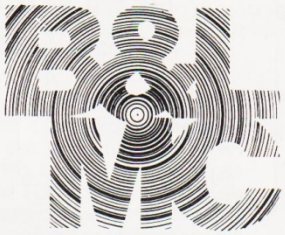

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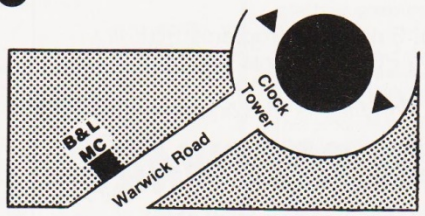

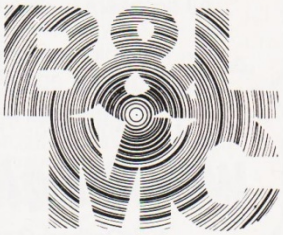

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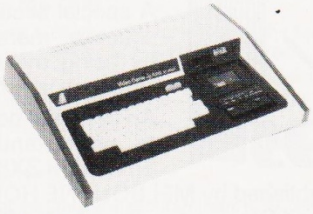

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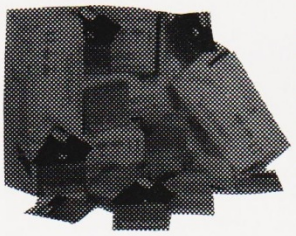

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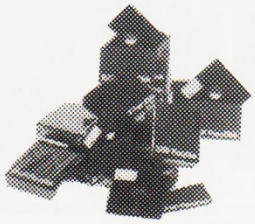

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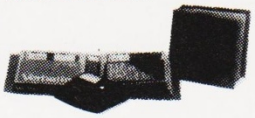

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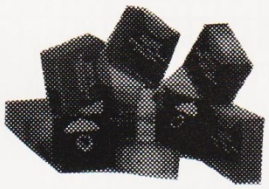

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Len Topple

A full simulation of that most versatile of research tools, the digital storage 'scope for the classroom

A normal oscilloscope is a very versatile piece of test equipment and is one of the basic tools to be found in most development laboratories and service workshops. While it has the fast response times necessary for studying the operations of modern digital ICs it keeps no permanent record of the signal. Once the screen phosphorescence has died away you have lost the information, unless you use photographic techniques.

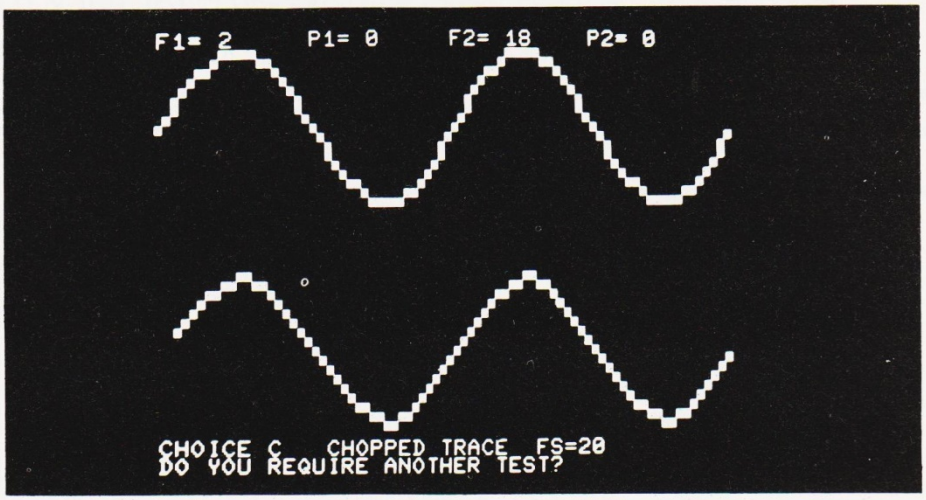
So, why not use an ultra-violet recorder? For slow response systems this may be adequate, although the recording paper is expensive. However, the speed of a UV recorder is about as slow compared to a 'scope as a bus is to Concorde! Perhaps we can use the oscilloscope in a different way?

The Digital Oscilloscope

One of the ways in which an oscilloscope can be enhanced is by fitting a 'storage' tube. This is very expensive, does not provide a permanent picture and can be damaged by misuse.

The logical alternative is to use computer technology and convert the analogue signal into a digital one with an A to D converter, store the resulting digital signal in RAM and then convert back through a D to A for display. The information stored can be captured, replayed, or otherwise inspected ad infinitum on a standard 'scope tube. We can even take small parts of the stored signal and expand them, something no other storage system can do.

All this sounds too good to be true — there has to be a catch somewhere. That catch is a phenomenon called aliasing. Consider what happens when you increase the frequency of a sinusoidal input; to make things simple, let's assume that the A to D is sampling every microsecond. If the frequency of the input signal is 10 kHz then each cycle on the display will consist of some 100 dots, and the waveform will appear smooth and undistorted. If we now increase the input frequency to 100 kHz we reduce the number of samples per cycle to 10 and the nature of the trace will become obvious. Worse still, if the input signal is greater than half that of the sampling frequency the display will actually appear to be of a *lower* frequency!



A chopped trace display with a sampling frequency of 20 Hz. Both traces are using dot-joining. The upper trace has a frequency of 2 Hz and is correctly displayed, the lower trace frequency of 18 Hz is greater than half the sampling frequency and appears as an alias frequency, FS-F2 or 2 Hz.

The whole purpose in producing this program for classroom demonstration was to show this together with the effects of limited resolution on a display system.

The Program Criteria

As well as demonstrating the effects of resolution and aliasing, the demonstration was also designed to show the modes of oscilloscope operation; single or dual trace, chopped or alternate sampling and to demonstrate the effects of dot-joining on the displayed waveform.

The entire program is menu driven and the user can select any of the modes of operation from this main display (see the accompanying photographs).

For any of the chosen modes of operation, test data concerning the frequency of the input and its relative phase can be input together with joined or un-joined traces. The main flowchart for the program is given in Fig. 1.

It can be seen immediately from the photographs that the resolution of the demonstration is poor; it uses the equivalent of a four-bit A to D (five-bit in the case of single trace) as compared to at least eight-bit converters in a digital scope.

How It Works

The program listed is written specifically for the Commodore PET computer fitted with the PIC CHIP available from Insel Computers. Routines are available which will perform the double density graphics

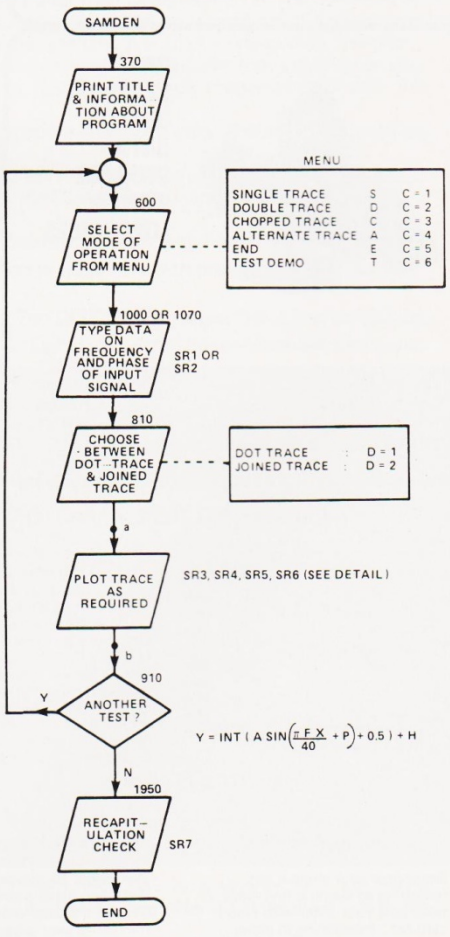


Fig. 1. Main system flowchart showing the relationships of each main section.

facility of the PIC CHIP, both in BASIC and machine code, but this method is somewhat easier!

The PIC CHIP is enabled by the

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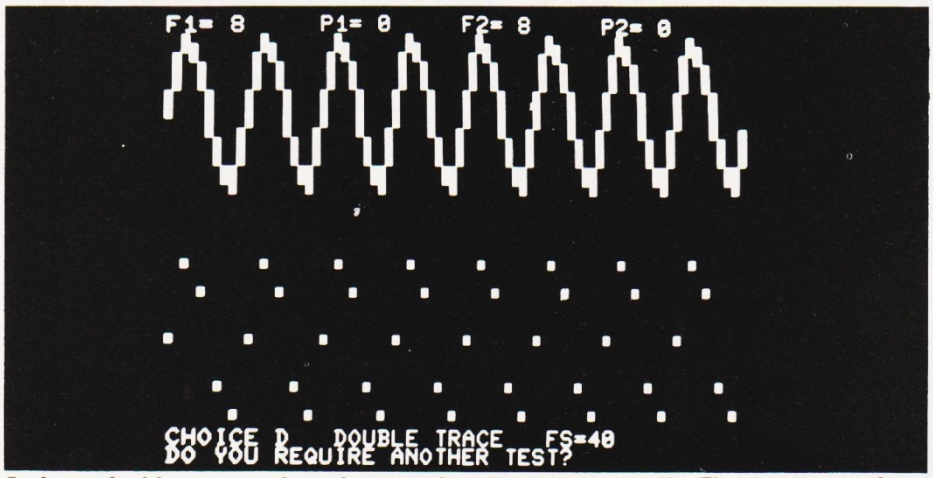
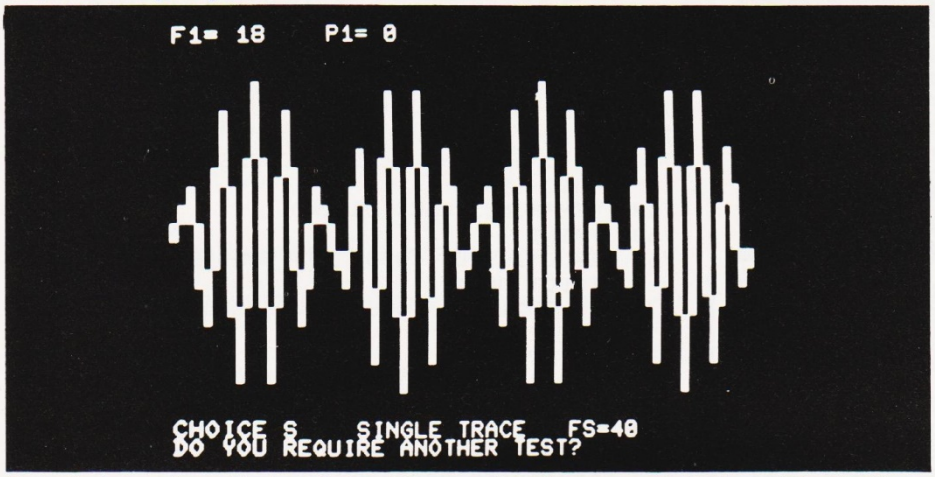


A plot in double trace mode with a sampling frequency of 40 Hz. The top trace is dot-joined, the lower is not. This shows the improvement in resolution gained, there are only five dots per cycle.



A single trace plot with dot joining. The sampling frequency is 40 Hz and the highly distorted display is a result of beating between the alias frequency of 22 Hz and the input frequency of 18 Hz. To avoid this kind of distortion a sampling frequency of some five times that of the highest input component must be used.

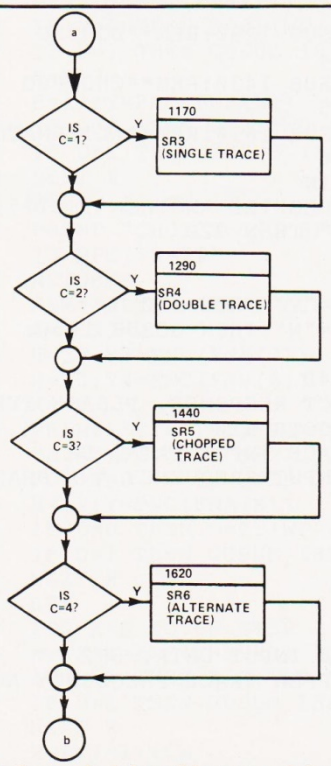


Fig. 2. Expanded detail between 'a' and 'b' of Fig. 1.

Subroutine	Function	Starts at
SR1	Single trace data input	1000
SR2	Dual trace data input	1070
SR3	Single trace plot	1170
SR4	Dual trace plot	1290
SR5	Chopped trace plot	1440
SR6	Alternate trace plot	1620
SR7	Exit routines	1950
SR8	Demonstration	2080
SR9	Delay	2410
SR10/11	Temporary store	1820/1890

Table 1. The main subroutines, their function and location within the program.

SYS36864 command at the start of the program, line 350, and the following four functions are used at various points in the program.

!WP This plots a pixel (¼ sized block) at a screen position of X,Y *relative* to the chosen origin.

!WL This draws a line of pixel points between X1,Y1 and the chosen X2,Y2 position.

!WC As !WC but in second and subsequent calls the new value of X1,Y1 is automatically set as the old value of X2,Y2.

!CW This positions the cursor so that normal PRINT commands can be combined with traces produced by PIC CHIP.

Although the resolution is limited to a quarter sized block, the cost of fitting a high resolution graphics option to the PET is excessive enough to make the existing situation acceptable.

The main flowchart shown in Fig. 1 indicates the main areas of the program and the functions that they can be expected to perform. The second flowchart in Fig. 2 is an expanded detail of the section between points 'a' and 'b' on Fig. 1.

All the main system variables are declared at the start of the program and the various routines are all commented.

Using It

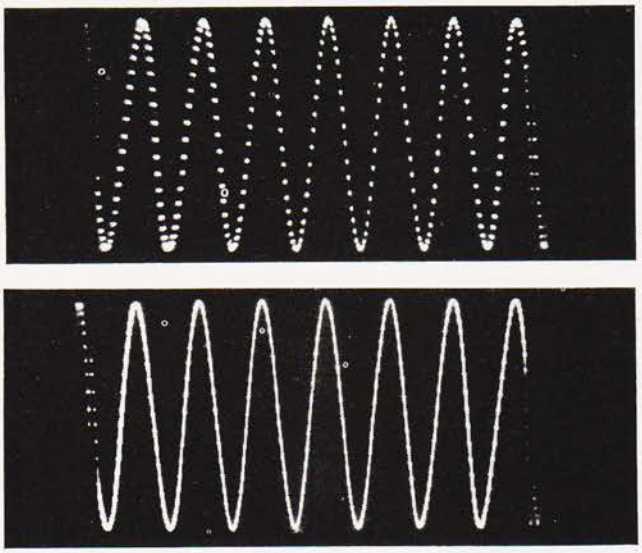
One way or another, you should now be ready to test the program. Although the program behaves exactly like a digital storage 'scope in most respects you ***cannot*** alter the sampling rate of the A to D converter. This, however, is of little importance in a simulation such as this because the display obtained is unchanged if both input frequency and sampling frequency are changed by the same factor.

It is worth outlining the component parts of a digital storage 'scope and the effect each has on the overall performance.

1) The resolution of the A to D converter controls the resolution of the Y axis.
2) The amount of memory available for signal storage determines the X axis resolution.
3) The D to A converter must have the same resolution as the A to D.
4) The clock for each of the converters should be capable of independent adjustment to give control over sampling rate and allow a clean display.

The problem of aliasing is common to ***all*** sampling methods and should be borne in mind whenever connecting your micro to the outside world. Shannon's sampling theorem states that the minimum sampling frequency should be ***twice*** the frequency of the input frequency.

Doubtless the program can be expanded and improved but in its current form it provides a useful and demonstrable system that contains all the major features of a true digital storage 'scope.



The real thing. The top photo shows a digital scope plot without dot joining, the lower has dot joining. The vast increase in resolution means that this device is indistinguishable in normal operation from an ordinary 'scope.

Program Listing

```
170  REM**VARIABLES AND FUNCTIONS
180  A=0:REM**AMPLITUDE OF WAVEFORM
190  C=0:REM**MODE SELECTION CONTROL
200  D=0:REM**DOT JOINING CONTROL
210  H=0:REM**X AXIS HEIGHT
220  K=PI/40:REM**CONSTANT USED IN DEF
230  F1=0:REM**FREQUENCY OF UPPER TRACE
240  F2=0:REM**FREQUENCY OF LOWER TRACE
250  P1=0:REM**PHASE OF UPPER TRACE IN RADS
260  P2=0:REM**PHASE OF LOWER TRACE IN RADS
270  X0=0:Y0=0:REM**USER ORIGIN
280  X1=0:Y1=0:REM**USED FOR DOT JOINING
290  X2=0:Y2=0:REM**USED WITH !WL AND !WC
300  X3=0:Y3=0:REM**TEMP STORE FOR X1,Y1
     UPPER TRACE
310  X4=0:Y4=0:REM**TEMP STORE FOR X1,Y1
     LOWER TRACE
320  DEF FNA(X)=A*SIN(K*F1*X+P1)
330  DEF FNB(X)=A*SIN(K*F2*X+P2)
340  DEF FNC(Y9)=INT(Y9+.5)+H
350  SYS 36864:REM**TURN ON PIC CHIP
360  REM**TITLE AND MODE CHOICE
370  PRINT "[CLS]"
380  PRINT:PRINT "[3 SPC]DIGITAL STORAGE
     OSCILLOSCOPE"
390  PRINT "[11 SPC]SIMULATION"
400  PRINT:PRINT
410  PRINT "ALL THE INPUTS USED IN THIS
     PROGRAM HAVE SINE WAVEFORMS"
420  PRINT "YOU WILL BE ASKED TO SELECT THE
     TYPE OF TRACE REQUIRED"
430  PRINT "YOU MAY CHOOSE THE INPUT
     FREQUENCIES AND PHASES"
440  PRINT "YOU MAY ALSO CHOOSE BETWEEN DOT
     AND CONTINUOUS PLOTS"
450  PRINT
460  PRINT "FIRST TIME USERS ARE ADVISED TO
     SELECT 'T' AT THE FIRST RUN"
470  PRINT "THIS DEMO WILL GIVE YOU AN IDEA
     OF THE FACILITIES AVAILABLE"
480  PRINT
490  PRINT "USE YOUR OWN TEST DATA TO
     EXAMINE"
500  PRINT "SAMPLING DISTORTION AND
     ALIASING"
510  GOSUB 2400:GOSUB 2400:REM**DELAY
520  PRINT:PRINT "[2 SPC]CODE[3 SPC]
     DESCRIPTION[6 SPC]SAMPLING FREQ."
530  PRINT "[4 SPC]T[4 SPC]DEMO TEST PROG."
540  PRINT "[4 SPC]S[4 SPC]SINGLE TRACE
     [8 SPC]40"
550  PRINT "[4 SPC]D[4 SPC]DOUBLE TRACE
     [8 SPC]40"
560  PRINT "[4 SPC]C[4 SPC]CHOPPED TRACE
     [7 SPC]20"
570  PRINT "[4 SPC]A[4 SPC]ALTERNATE TRACE
     [5 SPC]40"
580  PRINT "[4 SPC]E[4 SPC]END OF PROGRAM"
590  PRINT:PRINT
600  PRINT "SELECT FROM T,S,D,C,A,OR E"
610  GET A$:IF A$="" THEN 610
620  C=0
630  IF A$="S" THEN C=1
640  IF A$="D" THEN C=2
650  IF A$="C" THEN C=3
660  IF A$="A" THEN C=4
670  IF A$="T" THEN C=6
680  IF A$="E" THEN GOSUB 1950:REM**END
     ROUTINE, SR7
690  IF C=5 THEN 2440:REM**END
700  IF C=6 THEN GOSUB 2070:GOTO 910
710  REM**WRONG ENTRY
720  PRINT
730  IF C=0 THEN PRINT "INCORRECT RESPONSE":
     GOTO 590
740  REM**ONE TRACE OR TWO
750  PRINT
760  IF C=1 THEN GOSUB 990:REM**SINGLE TRACE
     INPUT DATA
770  IF C<>1 THEN GOSUB 1060:REM**DUAL TRACE
     INPUT DATA
780  PRINT
790  REM**DOT JOINING
800  D=0
810  PRINT "DO YOU REQUIRE DOT JOINING";
820  INPUT B$:IF LEFT$(B$,1)="Y" THEN D=1
830  REM**MAIN PROGRAM
840  PRINT "[CLS]"
850  REM**MODE SELECTION
860  IF C=1 THEN GOSUB 1160:REM**SINGLE
     TRACE MODE, SR3
870  IF C=2 THEN GOSUB 1280:REM**DOUBLE
     TRACE MODE, SR4
880  IF C=3 THEN GOSUB 1430:REM**CHOPPED
     TRACE MODE, SR5
890  IF C=4 THEN GOSUB 1610:REM**ALTERNATE
     TRACE MODE, SR6
900  REM**DO IT AGAIN
910  PRINT "DO YOU REQUIRE ANOTHER TEST?";
920  GET A$:IF A$="" THEN 920
930  PRINT "[CLS]"
940  REM**YES OR NO
950  IF LEFT$(A$,1)="Y" THEN 520
960  IF LEFT$(A$,1)="N" THEN GOSUB 1950:
     REM**SR7
970  IF C=5 THEN 2440
980  PRINT "INCORRECT RESPONSE. PLEASE TYPE
     Y OR N":PRINT:GOTO 910
990  REM**SINGLE TRACE INPUT DATA, SR1
1000 PRINT:PRINT "INPUT FREQUENCY AND PHASE
     DATA"
1010 PRINT
1020 INPUT "F=";F1
1030 INPUT "P=";P1
1040 RETURN
1050 REM
1060 REM**DUAL TRACE INPUT DATA, SR2
1070 PRINT:PRINT "UPPER TRACE FREQUENCY AND
     PHASE DATA"
1080 PRINT
1090 INPUT "F=";F1
1100 INPUT "P=";P1
1110 PRINT:PRINT "LOWER TRACE DATA"
```

```
1120  PRINT
1130  INPUT "F=";F2
1140  INPUT "P=";P2
1150  RETURN
1160  REM**SINGLE TRACE PLOT, SR3
1170  A=16:H=23:X1=0:Y1=FNC(FNA(0))
1180  PRINT:PRINT "F1=";F1,"P1=";P1
1190  FOR X=0 TO 80 STEP 2
1200  Y=FNC(FNA(X))
1210  IF D=0 THEN D=0:!WP:REM**TRACE WITHOUT
      DOT JOINING
1220  REM**D=0 IS A DUMMY INSTRUCTION
1230  IF D=1 THE X2=X:Y2=Y:!WC:REM**!WC IS
      THE AUTO LINE JOINING FUNCTION
1240  NEXT X
1250  X=0:Y=1:!CW
1260  PRINT "CHOICE S[3 SPC]SINGLE TRACE
      [3 SPC]FS=40"
1270  RETURN
1280  REM**DOUBLE TRACE PLOTS, SR4
1290  A=8:H=37:X3=0:Y3=FNC(FNA(0))
1300  PRINT "F1=";F1,"P1=";P1,
      "F2=";F2,"P2=";P2
1310  FOR X=0 TO 80 STEP 2
1320  H=37
1330  Y=FNC(FNA(X))
1340  IF D=0 THEN D=0:!WP
1350  IF D=1 THEN GOSUB 1810
1360  H=13
1370  Y=FNC(FNB(X))
1380  !WP
1390  NEXT X
1400  X=0:Y=1:!CW:REM**!CW POSITIONS THE
      CURSOR
1410  PRINT "CHOICE D[3 SPC]DOUBLE TRACE
      [3 SPC]FS=40"
1420  RETURN
1430  REM**CHOPPED TRACE PLOTS, SR5
1440  A=8:X3=0
1450  H=37:Y3=FNC(FNA(0))
1460  X4=2
1470  H=13:Y4=FNC(FNB(2))
1480  PRINT "F1=";F1,"P1=";P1,
      "F2=";F2,"P2=";P2
1490  FOR X=0 TO 80 STEP 2
1500  H=37:Y=FNC(FNA(X))
1510  IF D=0 THEN D=0:!WP
1520  IF D=1 THEN GOSUB 1810
1530  X=X+2
1540  H=13:Y=FNC(FNB(X))
1550  IF D=0 THEN D=0:!WP
1560  IF D=1 THEN GOSUB 1880
1570  NEXT X
1580  X=0:Y=1:!CW
1590  PRINT "CHOICE C[3 SPC]CHOPPED TRACE
      [3 SPC]FS=20"
1600  RETURN
1610  REM**ALTERNATE TRACE PLOTS, SR6
1620  A=8:X3=0
1630  H=37:Y3=FNC(FNA(0))
1640  H=13:Y4=FNC(FNB(0))
1650  X4=0
1660  PRINT "F1=";F1,"P1=";P1,
      "F2=";F2,"P2=";P2
1670  FOR X=0 TO 80 STEP 2
1680  H=37:Y=FNC(FNA(X))
1690  IF D=0 THEN D=0:!WP
1700  IF D=1 THEN GOSUB 1810
1710  NEXT X
1720  REM
1730  FOR X=0 TO 80 STEP 2
1740  H=13:Y=FNC(FNB(X))
1750  IF D=0 THEN D=0:!WP
1760  IF D=1 THEN GOSUB 1880
1770  NEXT X
1780  X=0:Y=1:!CW
1790  PRINT "CHOICE A[3 SPC]ALTERNATE TRACE
      [3 SPC]FS=40"
1800  RETURN
1810  REM**TEMP STORE, SR10, USED WITH SR4,
      SR5, SR6
1820  X1=X3:Y1=Y3
1830  X2=X:Y2=Y
1840  !WL
1850  X3=X2
1860  Y3=Y2
1870  RETURN
1880  REM**TEMP STORE, SR11, USED WITH SR5
      AND SR6
1890  X1=X4:Y1=Y4
1900  X2=X:Y2=Y
1910  !WL
1920  X4=X2:Y4=Y2
1930  RETURN
1940  REM**END SUBROUTINE, SR7
1950  PRINT "[CLS]"
1960  PRINT "END OF PROGRAM"
1970  C=5:REM**CONTROL FOR END
1980  PRINT:PRINT "YOU SHOULD BY NOW
      UNDERSTAND THE FOLLOWING"
1990  PRINT:PRINT "1. CHOPPED AND ALTERNATE
      TRACE MODES OF OPERATION"
2000  PRINT "2. THE EFFECT OF LIMITATIONS IN
      X & Y RESOLUTION"
2010  PRINT "3. DISTORTION EFFECTS DUE TO A
      SMALL NO OF SAMPLES PER CYCLE"
2020  PRINT "4. WHAT IS MEANT BY 'ALIASING'"
2030  PRINT:PRINT:PRINT "IF NECESSARY REPEAT
      SOME OF THE TESTS USING NEW DATA"
2040  PRINT:PRINT
2050  PRINT "GOODBYE"
2060  RETURN
2070  REM**TEST DEMO, SR8
2080  PRINT "[CLS]"
2090  PRINT "DEMO TEST PROGRAM"
2100  C=1:D=0
2110  READ F1,P1
2120  GOSUB 1160:REM**SR3
2130  GOSUB 2400:REM**SR9
2140  REM
2150  C=2:D=1
2160  READ F1,P1,F2,P2
2170  PRINT "[CLS]"
2180  GOSUB 1280:REM**SR4
2190  GOSUB 2400
2200  REM
2210  C=3
2220  READ F1,P1,F2,P2
2230  PRINT "[CLS]"
2240  GOSUB 1430:REM**SR5
2250  GOSUB 2400
2260  REM
2270  C=4
2280  READ F1,P1,F2,P2
2290  PRINT "[CLS]"
2300  GOSUB 1610:REM**SR6
2310  GOSUB 2400:GOSUB2400:REM**DOUBLE NORMAL
      DELAY
2320  PRINT "[CLS]"
2330  RESTORE
2340  REM**DATA FOR DEMO
2350  DATA 5,2
2360  DATA 12,0,12,0
2370  DATA 8,0,12,0
2380  DATA 37,1,53,1
2390  RETURN
2400  REM**DELAY SUBROUTINE, SR9
2410  T1=TI:REM**TI IS PET'S INTERNAL CLOCK
      COUNTER
2420  IF TI-T1<420 THEN 2420
2430  RETURN
2440  REM**RESTORE NORMAL FUNCTIONS
2450  !CO:REM**PIC CHIP OFF
2460  SYS 45056:REM**TOOLKIT ON
2470  REM**THAT'S IT!
2480  END
```

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MAKING MUSIC

A tuneful diversion for TRS-80 or Video Genie owners that carries a seasonal message

If you've ever become bored while looking at your computer's display in stony silence, you might have thought of trying your hand at computer-generated music. Failing that, you might at least want to generate the bleeps, bloops and blips which help to make some games so addictive.

Some computers have built-in loudspeakers (eg the Sharp MZ80s), but that makes life too easy. With others, like the TRS-80, you can drive (for example) the cassette I/O port into a soundbox; given the right signals, that can make some interesting sounds. A few computers, and the Video Genie is an excellent example, make life much more complex, however.

Although the Genie is based upon the TRS-80, its built-in cassette means that the Tandy trick will not work. True, it has a cable for a second cassette port, but have you ever tried controlling it via machine code? It's not as easy as it should be. I know that for around £10 to £15 you could buy a V G sound kit, but that's the coward's way out.

In this article, we'll outline the simplest way of generating music with a micro, and describe how, if you're lucky, you can modify the TV you're already using as a monitor so that it can also act as a soundbox. We'll then explain one way in which you can make the Genie talk to that, or any other, soundbox via its second cassette interface.

To complete the picture, there's a short machine-code subroutine and an accompanying Level II BASIC program that will actually produce a tune from a Genie or a TRS-80. Don't expect Beethoven though — the simple approach described generates a square wave signal which will normally be filtered by the TV's rotten amplifier and loudspeaker into something approaching a sine wave.

Making Noises

The simplest and cheapest way to get notes out of a micro is to use the system to generate an audio frequency square wave. A computer can produce a square wave much more easily than a pure sine wave — it's a digital device, and switching a signal line backwards and forwards between '0' and '1', at regular intervals, will do the job. The trick comes when we consider how to generate a signal of the right frequency and duration.

Since we are looking for the simplest possible system, the easiest way to get the frequency and duration is via a pair of nested loops in a short program. Figure 1 is a flowchart that shows the principle. The inner loop, which generates the note, is controlled by counter Y, which is initialised to a value such that the inner loop runs for exacly half the period of the desired note. For a note of frequency 'f', the length of this inner loop ('t') is given by:

$$t = 1/2f$$

At the end of each Y-loop, the output level is flipped — two flips and the computer has generated a single cycle of the waveform.

The duration of the note is controlled by the X-loop, which directly controls the number of cycles generated. For a half-second of A' (440 Hz), X would have an initial value of 220, less any allowance for the routine's incidental activities. It is not so easy to calculate what value of Y to use for any given note, since this will depend on minor factors such as the program used, what micro it runs on, the system's clock speed, etc. Later in this article we'll describe a Z80 routine to do the job, with timings for a TRS-80, or Video Genie.

Why is it acceptable to produce a square wave instead of the pure sine wave that would presumably be the optimum answer? After all, an elementary knowledge of Fourier Analysis (!) tells us that a square wave is made up of many notes, all multiples (harmonics) of the basic frequency (the fundamental). In fact, the technique relies on two phenomena.

In the first place, unless you are using a very hi-fi system as a soundbox, you will not be able to reproduce frequencies above around 4-5 kHz. This will filter off the higher harmonics but won't do much for the lower ones, which contain most of the distortion anyway.

The second, and more important, reason relates to the way that your ears and brain work. If you listen to a square- (or any other-) wave, you perceive only the fundamental. You do not hear the harmonics as discrete notes, but only as a harshening of the fundamental (the hi-fi buff's harmonic distortion).

You have probably realised that I have only skimmed the surface of a very complex subject, but I hope that I have made the point that it is not difficult, in theory, to generate music of a sort with a micro. Let's get on with the practical part now.

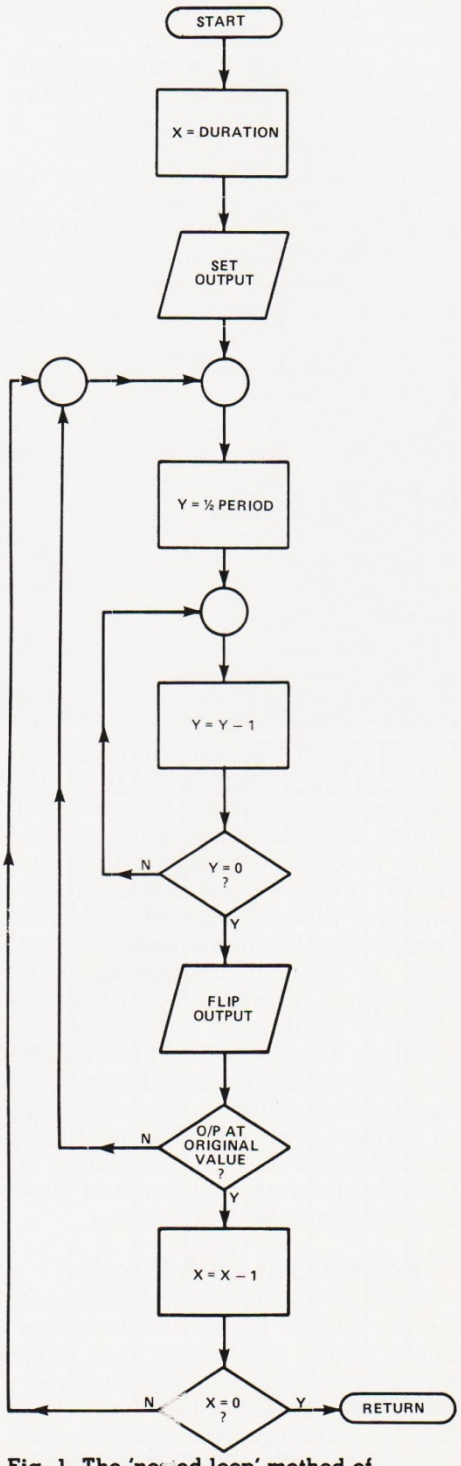

Fig. 1. The 'nested loop' method of note generation in flowchart form.

Making A TV Into A Soundbox

First, a vital word of warning — **TVs CAN BE LETHAL.** Unless you are absolutely certain what you are doing, do not attempt to modify a TV.

Having said that, it is possible to modify many portable TVs to act as audio amplifiers without affecting their ability to display the output from a computer. I use a Prinzvision TV121 black and white portable with my computer, and my remarks apply specifically to that model; however, I believe that the same basic set, which is made in Taiwan, is marketed under many other brand names.

If you study the set's circuit diagram, you will see that, in the audio chain, there is a block of circuity similar to that shown in Fig. 2. The output from the audio demodulator passes, via an amplifier, to a potentiometer which acts as the volume control. The pot's output goes to the AF power amplifier which, in turn, drives the loudspeaker.

Break the circuit at 'X' and insert a 3.5mm jack socket as shown in Fig. 3. The TV will then work normally until you insert a jack, upon which the output from the AF demodulator is broken and the jack is connected to the input of the power amp. Drive a small signal (around 200mV) into the jack and you will hear it at the speaker.

If you use a chassis-mounting socket you should be able to mount it on the side of the TV, all ready to plug in an audio signal. When you actually plug the computer in, you may find that you get more than you bargained for. A micro is a splendid source of video frequency noise, which the audio lead may radiate into the TV, giving a noisy display. If this happens, a small capacitor (around 22nF) across the jack should filter out most of the interference. This capacitor is shown dotted in Fig. 3.

Once again, do ***not*** attempt to modify a TV unless you understand precisely what you are doing. The modification relies on the set having an ***earthed*** chassis and is thus likely to be feasible only on a portable. A TV with a floating chassis could blow up your computer . . . and you.

Sound Out Of A Genie

Now, if you have modified your TV, or if you have an alternative small audio amp, you can take signals from your computer and hear the effect. This is not too hard with a TRS-80, but how can you drive a Genie's second cassette interface?

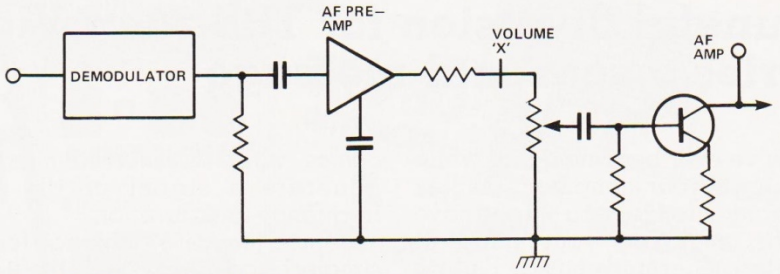

Fig. 2. The block diagram of the TV audio chain.

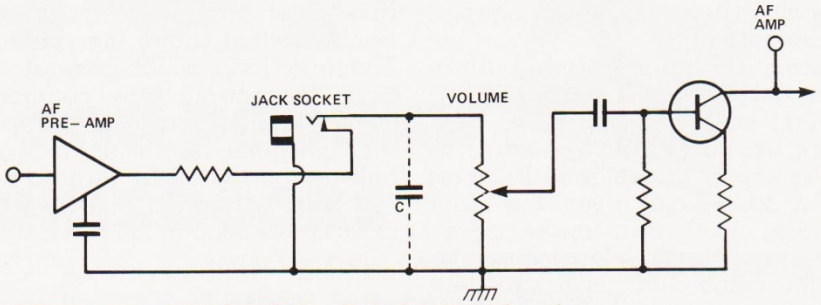

Fig. 3. Where you need to break the chain for the jack socket.

Like the TRS-80, the Genie drives cassette recorders via I/O port 255; specifically, it uses the three least significant bits of the eight-bit port. Bit 2 (decimal '4') switches the cassette relay on and off, and bits 0 and 1 (Fig. 4) control the level of the audio signal to the recorder. These signals, at least on my Genie, are sent along the yellow lead of the second cassette lead.

The standard TRS-80 way of generating noises is to toggle bit 0 up and down to drive an amplifier, but the Genie is not quite that simple. As well as switching on the cassette motor, the relay also isolates the cassettes I/O connections. Thus, before you can drive any outputs, bit 2 of port 255 must be set to, and held at, 1 in order to close the relay.

The actual output level depends on the data in bits 0 and 1. Table 1 shows the DC voltages that my Genie produces for the four possible combinations. You can therefore select the right pairs of data values to give a suitable signal amplitude for your amplifier. For my modified TV, I toggle between 6 and 7 to give a signal swing of 178mV peak-to-peak.

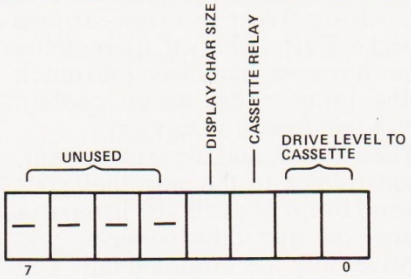

Fig. 4. Which bits do what in the output port.

OUTPUT DATA	DC OUTPUT (mV)
4	210
5	430
6	12
7	190

Table 1. Corresponding voltage values for varying bit values at the output port.

Right, let's try something simple. Connect your Genie to your amplifier and input this program:

```
10 OUT 255 ,6
20 OUT 255 ,7
30 GOTO 10
```

and RUN it.

Chances are that you hear nothing but, if you look, you'll see that the 'CASSETTE' indicator light has come on. What's wrong?

It turns out that the Genie drives both cassettes from the same I/O port, and contains internal latches to decide which one to use. The default condition is Cassette 1, but somehow we have to drive Cassette 2.

BREAK the program and enter OUT 254,16. This selects the second cassette; that is where any cassette data will go until the first cassette is reselected. To reselect Cassette 1, you can either use an instruction which addresses it explicitly (eg PRINT#-1,), or you can use OUT 254,0.

RUN the program again. You should hear a disgusting buzz. It's not very musical but at least it's a sound. That's a good place to stop for today.



Making 'Proper' Music

You have probably realised from what we've done so far that BASIC alone is not enough to generate pleasant music.

We have to use a machine code subroutine before we can advance further. At this stage we should look for one to play a simple, single-voice, melody. Barber-shopping sounds nicer, but is much more complicated. We saw earlier, in Fig. 1, a flowchart of a suitable procedure — it only remains to convert it into suitable code.

Listing 1 is a Z80 assembly language subroutine, suitable for a TRS-80 or Video Genie, which implements Fig. 1. It expects to find the half-period count ('Y' in Fig. 1) in register D, and the duration count ('X') in HL. The routine starts with a CALL to 0A7F Hex, which is the computers' built-in subroutine to transfer HL to a machine code segment from BASIC.

The BASIC program will pass the value of D by POKEing it directly into the correct point in the subroutine; Listing 1 therefore shows D being loaded with 'DUMMY', just to reserve a byte. The two 'OR A's in the inner loop simply pad out its duration to give a reasonable range of notes.

You will probably have noticed that, although the routine is totally relocatable, it has been assembled into memory locations 405E to 4079 Hex. This makes use of a block of RAM from 405C to 407F Hex that the TRS-80 and VG only use during a cold start. This is handy spot to put short machine code segments like this since it avoids the need to set the memory size, etc.

Before we can make music, we have to know what sort of numbers go into D and HL to give specific notes. Given a knowledge of the number of clock cycles required by each instruction, and of the computers' clock frequency, this is a straight-

NOTE	FREQ (Hz)	D	HL	NOTE	FREQ (Hz)	D	HL
C,	131	252	65	F#	370	88	184
C#,	139	238	69	G	392	83	195
D,	147	225	73	G#	415	78	206
D#,	156	212	78	A'	440	74	218
E,	165	200	82	A'#	466	70	231
F,	175	189	87	B'	494	66	245
F#,	185	178	92	C'	523	62	259
G,	196	168	98	C'#	554	58	274
G#,	208	158	103	D'	587	55	291
A	220	149	110	D'#	622	52	308
A#	233	141	116	E'	659	49	326
B	247	133	123	F'	698	46	345
C	262	125	130	F'#	740	43	365
C#	277	118	138	G'	784	41	386
D	294	112	146	G'#	831	38	409
D#	311	105	155	A"	880	36	433
E	330	99	164	A"#	932	34	458
F	349	94	173	B"	988	32	485

Table 2. Note, frequency and the corresponding values for the D and HL registers.

forward, if tedious (let the computer do it) calculation.

To save you the bother, Table 2 shows values of D to give a useful range of three octaves with a (roughly) equal-tempered scale. It also gives the values of HL needed for a half-second note at each pitch. You may wonder why HL is not exactly half each note's frequency — it's different because of the effect of the outer loop's instructions, and because the need for integer values of D gives only approximations to each note. You should also be aware that the numbers in Table 2 are only right for the standard TRS-80/VG clock rate of 1.79 MHz; other computers will need the different values.

Playing The Tune

How do we use the machine-code segment? Listing 2 is a short BASIC program that brings all the pieces together.

Once the program has read the machine code routine and put it into RAM, it reads the tune's SPEED from a DATA statement. This approach gives an easy way of changing the tempo without altering all the individual notes' durations. Double the value of SPEED and you half the length of each note.

Before the tune is actually played, the OUT 254,16 in line 260 sets the cassette selection latch. Alternatively, you could do this is immediate mode. Line 260 is not needed for TRS-80s, which will output the tune from their normal cassette port.

From here, the BASIC program reads values of PITCH (D) and PERIOD (HL) from DATA statements to play the tune. PERIOD is scaled by SPEED before it goes into HL.

A zero value of PITCH ends the tune, and a negative value gives a call to a BASIC subroutine to generate rests. With SPEED set to 1, a value of -240 gives a half-second pause to match the half-second notes of Table 2.

When the tune has been played, the program offers you the choice of playing it again — if you take this up, then the OUT 254,16 out of line 260 is not needed. At the end of the program, the OUT 254,0 in line 560 reselects Cassette 1.

Obviously, this is just a demo program with a fixed tune, but it could serve as a good basis for experiment. For example, try writing a musical scribbling pad which holds the pitch and duration data in arrays, and which includes code to write and manipulate those arrays. That, and anything else you may think of, I leave to you, but here are a few tips.

Because a single byte is used to time the frequency loop, PITCH cannot be larger than 255. For lower notes, put more dummy operations in the machine code's inner loop.

The result of the calculation in the USR brackets, which defines the note's duration, must be a signed 16-bit integer, allowing a maximum of 32767. In all honesty this should be long enough for anyone, but be warned that larger values will crash the program.

A simple program like this cannot play harmonies. Neither can it vary a tune's amplitude. The best sort of music to play is therefore straightforward solo songs. If you really want to experiment, how would you go about generating harmonies via this basic approach?

Program Listing

```
405E  CD 7F 0A  MUSIC   CALL 0A7F    GET HL
4061  16 00               LD D,DUMMY  DUMMY TO
                                      SET TONE
4063  3E 06      LOOP1    LD A,6      INITIAL VALUE
4065  D3 FF      LOOP2    OUT(255),A  OUTPUT TO
                                      CASSETTE
4067  42                 LD B,D      GET TONE DELAY
4068  F6 00      LOOP3    OR 0        DUMMIES FOR..
406A  F6 00                OR 0        ..PAUSE
406C  10 FA                DJNZ LOOP3  1/2 CYCLE DONE?
406E  EE 01                XOR 1       FLIP LSB OF A
4070  FE 06                CP 6        FULL CYCLE DONE?
4072  20 F1                JR NZ,LOOP2 IF NO, BACK AGAIN
4074  2B                   DEC HL      DEC DURATION
4075  7C                   LD A,H      IS..
4076  B5                   OR L        ..HL..
4077  20 EA                JR NZ,LOOP1 ..ZERO?
4079  C9                   RET         FINISHED
```

Listing 1. The Z80 code subroutine to implement the program shown in Fig. 1.

```
  200  REM**LOAD MACHINE CODE
  210  FOR X=16478 TO 16505:REM**405C TO 407F HEX
  220  READ X1:POKE X,X1
  230  NEXT X
  240  POKE 16526,94:POKE 16527,64:REM**SET USR
       START ADDRESS
  250  READ SPEED:REM**VARY TO CHANGE TEMPO
  260  OUT 254,16:REM**SET CASSETTE#2 LATCH
  300  CLS
  310  PRINT "READY - PRESS ANY KEY TO START"
  320  IF INKEY$="" THEN 320;REM**KEY NOT PRESSED
  330  READ PITCH
  340  IF PITCH=0 THEN 510:REM**END OF TUNE
  350  IF PITCH<0 GOSUB 2000:GOTO 330:REM**PAUSE
  360  POKE 16482,PITCH:REM**NOTE INTO M/CODE
  370  READ PERIOD
  380  A=USR(PERIOD/SPEED):REM**PLAY THE NOTE
  390  GOTO 330:REM**NEXT NOTE
  500  REM**WRAP-UP ROUTINES
  510  PRINT:PRINT "PLAY IT AGAIN, SAM?"
  520  Q$=INKEY$:IF Q$="" THEN 520
  530  IF Q$="Y" THEN GOSUB 1000:GOTO 330
  540  IF Q$<>"N" THEN 520
  550  OUT(255),0:REM**RELAY OFF
  560  OUT 254,0:REM**CLEAR CASSETTE#2 LATCH
  570  END
  999  REM**RESET THE DATA POINTER TO THE START
       OF THE TUNE
 1000  RESTORE
 1010  REM**CLEAR THE M/CODE DATA OUT OF THE WAY
 1020  FOR X=1 TO 29:READ X1:NEXT X
 1030  RETURN
 1999  REM**GENERATE A PAUSE
 2000  FOR XX=PITCH/SPEED TO 0:NEXT XX
 2010  RETURN
10000  REM**DATA FOR M/CODE
10010  DATA 205,127,10,22,0,62,6,211,255,66,246,
       0,246,0,16,250,238,1,254,6,32,241,43,
       124,181,32,234,201
20000  REM**DATA FOR MUSIC
20010  DATA .5:REM**SPEED
20020  DATA 225,36,168,49,168,73,178,23,168,49,133,
       61,133,61,149,55,112,73,112,73,112,109,125,
       32,133,61,149,55,133,123,-30
20030  DATA 225,36,168,49,168,73,178,23,168,49,133,
       61,133,61,149,55,112,73,149,55,149,82,178,
       23,178,46,200,41,225,73,-30
20040  DATA 112,73,112,73,112,73,168,49,125,65,
       133,61,133,61,149,55,-20,112,73,112,73,
       112,73,168,49,125,65,133,61,133,61,149,
       55,-20
20050  DATA 99,82,99,82,99,82,112,73,125,65,133,
       61,125,130,149,55,133,31,125,32,112,110,
       168,24,168,49,149,55
20060  DATA 133,123,-60,99,123,99,41,99,82,112,
       73,125,65,133,61,125,130,149,55,133,31,
       125,32,112,110,168,24,168,49,149,55,168,
       98,0
```

Listing 2. A BASIC program for the Genie with the machine code built in. It'll play you a tune if you get it right.

sinclair ZX81 PERSONAL COMPUTER





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



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

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

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

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

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



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

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Higher specification, lower price – how's it done?
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- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
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- Unique syntax-check and report codes identify programming errors immediately.
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Kit or built – it's up to you!
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uter-



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

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

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

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

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

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

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

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

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How to order your ZX81

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

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

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

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

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

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How the ZX81 compares with other personal computers

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

Sinclair software on cassette.

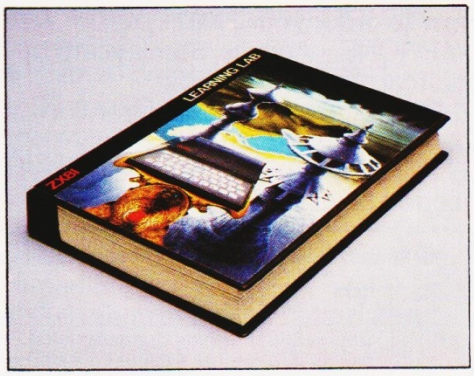


The unprecedented popularity of the ZX Series of Sinclair Personal Computers has generated a large volume of programs written by users.

Sinclair has undertaken to publish the most elegant of these on pre-recorded cassettes. Each program is carefully vetted for interest and quality, and then grouped with others to form single-subject cassettes.

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

The ultimate course in ZX81 BASIC programming.



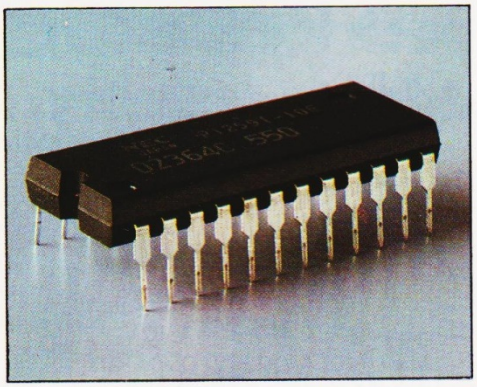
Some people prefer to learn their programming from books. For them, the ZX81 BASIC manual is ideal.

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

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

Full details with your Sinclair ZX81.

If you own a Sinclair ZX80...



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

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

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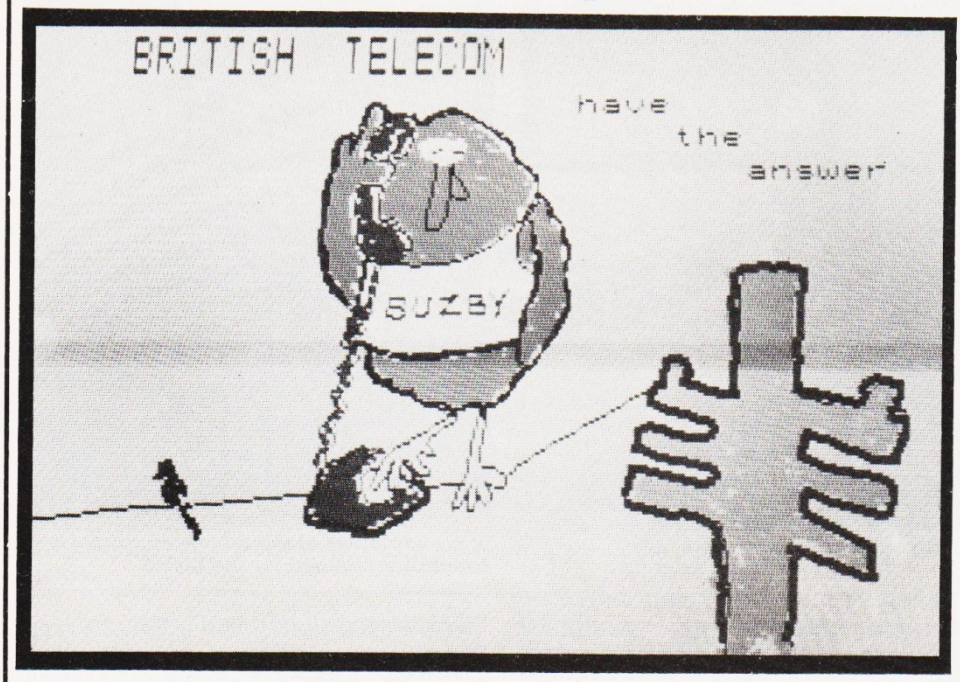
Henry Budgett

ON-SCREEN INFO

Part 2 of our lighthearted and informative trek through the science of Information Technology. This month we present Prestel, BT's implementation of Viewdata



In last month's issue I introduced the subject of Information Technology by outlining the two different types of service available to the public. To recap, these are the broadcast Teletext service and the interactive Viewdata service.

This month it's the turn of the latter system, Viewdata, to come under the editorial microscope. Before I chuck myself in at the proverbial deep end there is one small aspect to iron out. When Viewdata was first conceived the organisation that its inventor worked for was called The Post Office. However, in recent Governmental attempts to bring rationality to the various parts of that organisation (ie to separate the profit making from the non-profit making) the part which controlled the Viewdata operation became British Telecom. Throughout this article I will use the latter name even though it really only came into effect on 1st October 1981.

What Is Viewdata?

In the simplest possible terms it is a computerised public data base. But, so is Teletext and they are supposed to be different! The difference is that with Teletext you can only take information out, with Viewdata you can also put information in.

To get information back to the system one needs some form of communication system and the obvious choice is the telephone network. I'll explain the technical side in a moment but basically one just dials a special number which connects your TV to the computer as a terminal. You can get information out by keying its specific page number, much as you do with Teletext, but because the communication is two way you can answer questions that the system asks.

Because of this interaction the number of ways in which one single piece of data can be accessed goes up astronomically. Take, as an example, the time of a British Airways flight from London to Athens. You could get this directly by looking up the correct page in the published directory, or by going through the various travel indexes on the system itself. You might even find that it was carrying people on a package holiday so you might have a route from the holiday index, or the airline might be offering standby seats so you could find the same information through those pages. If this sounds awfully complicated then you're right, it is. But, the ***user*** is never really aware of it because at every point along the route there will always be a number of options.

These choices mean that instead of having to key in the absolute number of the page you want, as in the Teletext system, you can key one of up to 10 option numbers. The system then sorts out where you actually want to go. I don't know the actual percentages but of the 193,494 pages of information on the system a large proportion must be routeing pages that only contain the options avaiable at that point.

From Genesis To Exodus

The original concept of an interactive public information system was propounded back in the early 1970s by a gentlemen called Sam Fedida. At that time he was engaged in research at the BT establishment at Dollis Hill. Although no exact date appears to be available we do know that a feasibility study was undertaken between 1972 and 1974. The first published reference that I can find is a document by Fedida which formed part of the proceedings of EUROCOMP in 1975 called **Viewdata: An Interactive Information Service for the General Public.**

The first trial system was implemented on a Hewlett Packard 2100 with a database of some 300 screenfuls of information. At this point a couple of items of terminology rear their ugly heads. A screenful of information is called a PAGE. The piece of information you are looking for is called the END PAGE and the various pages that you are offered along the route are known as FILIALS (the sons of the PARENT PAGE). In some cases, as seen in Teletext, one page does not have sufficient room to hold all the information so sub-pages or FRAMES are added. These have the same address as the parent page (more of which anon) but with a letter suffix and cannot be accessed directly.

Back to the story once more. In the early days there was no common standard (is there one now?) and the format in which the information was presented looked very different to that which we know today. It soon became obvious that compatibility with the Teletext system would be an essential requirement in order to keep the cost of set production down and these basic standards were set up in September 1975.

The necessary authority to launch a public trial was given at this time, a full demonstration system now existed and was demonstrated at

EUROCOMP in September of that year. The trial started in January 1976 and gave the set manufacturers (BREMA) and the various Information Providers (IPs) a chance to see what the user needed. The main criticism of this trial is that it was *very* limited as a result of a shortage of Viewdata terminals.

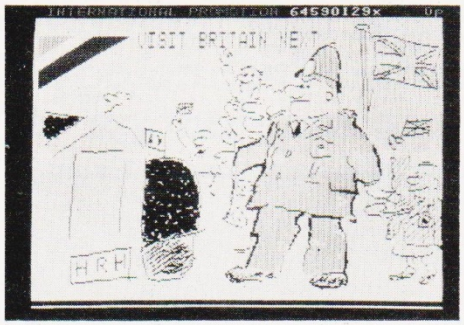
A full Market Trial was proposed in early 1977 and some £3m was allocated for the service. However, public interest had outstripped the capacity of the system at this stage and in September 1979 the Public Service went 'live'. Indeed, the launch was so advanced that the results of the Market Trial, now renamed the Test Service, were not available!

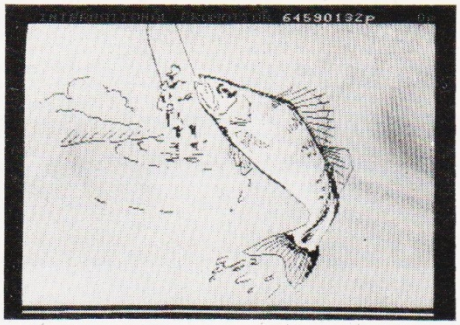
Those of you with long memories, or a full set of Computing Today, might recall my article published in May 1979 which anounced the launch of the London Residential Service on 26th March 1980. The comment at the end of that article is, I believe, still valid despite the events of the last few years!

The public Viewdata service was now given the name Prestel, after several false starts, and since that date has expanded at a reasonable rate in terms of the amount of information available. The growth in the number of users has been slightly less spectacular and, at the moment of writing there are some 11,466 users registered.

A Technical Brief

Last month I explained that the Teletext system used a special sort of transmission system called Synchronous Serial Transmission. At the time I mentioned that this was different to the normal method of communicating with a computer, Asynchronous Serial Transmission. Well, Viewdata is just an ordinary computer so we can use the ordinary method of communication.



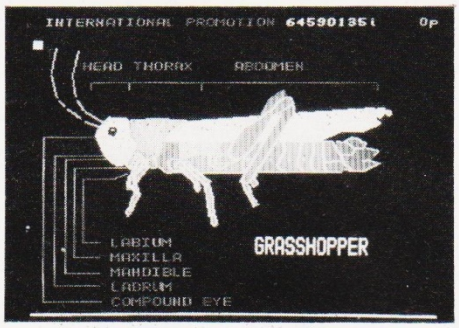


Er..almost, because there's one little problem.

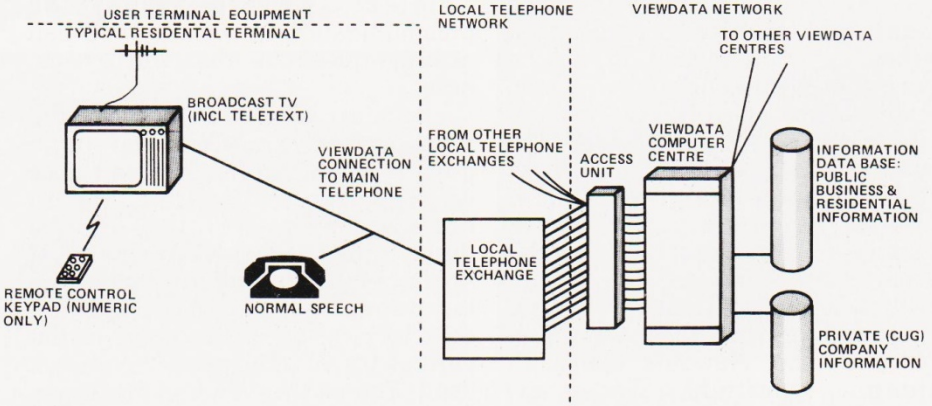
The user wants to get his information as quickly as possible, after all he's paying for the time he's logged onto the computer and the 'phone call. We therefore want the computer to send us the data as quickly as possible — 1200 baud is a reasonable speed. But, we also want to talk back. As we type much slower than a computer can transmit, let's use 300 baud to send our information back. We can't! The problem is that the telephone system cannot handle duplex operation at this speed (duplex simply means that A can talk to B at the same time as B talks to A).

In fact we are limited to sending information back at 75 baud until System X arrives. It doesn't really make all that much difference, though.

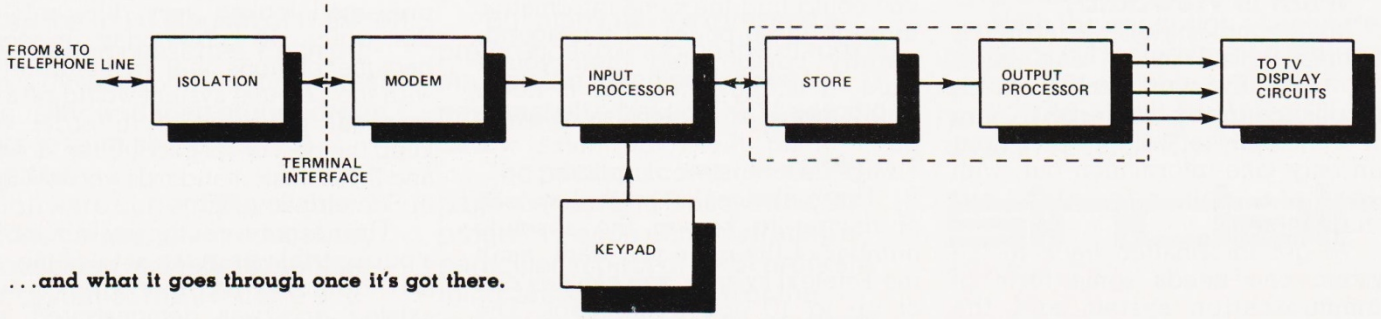
All the mechanical operations have been reduced to a minimum by the new generation of TV sets and adaptors. All you do is plug the jack into the special socket beside your 'phone, connect the aerial lead if you've got an adaptor, and press the Viewdata button. The system will generally offer you a choice of computers, there are four in London



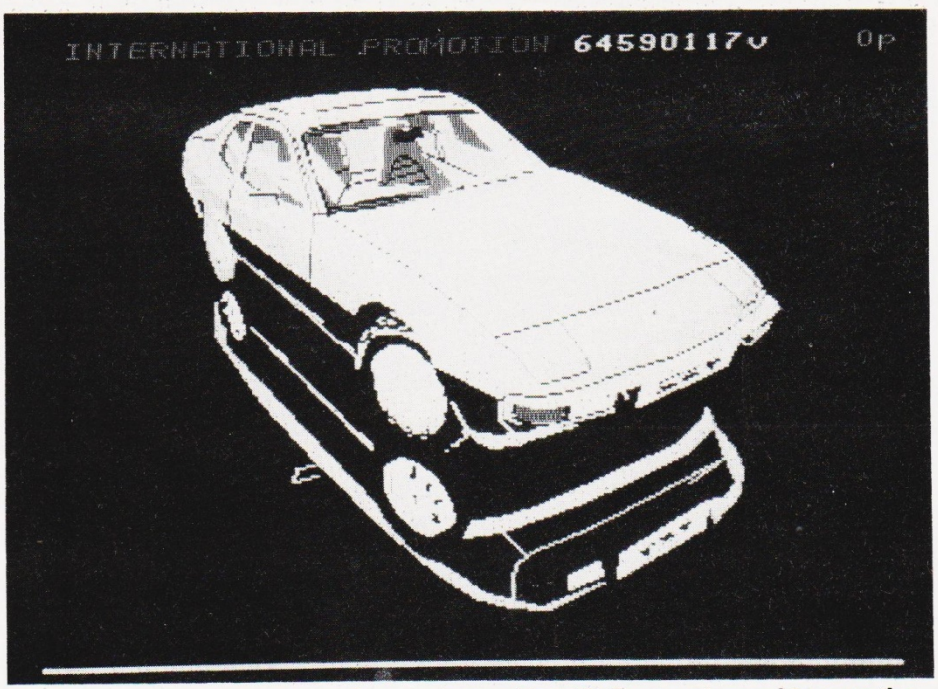
Some examples of the advanced graphics capability planned for the future.



How the information gets from the Prestel computer to your office or home...



...and what it goes through once it's got there.



Another example of Prestel graphics, compare this with the mosaic graphics over the page.

and various others round the country although the network is to be rationalised soon. Simply press the button corresponding to your choice and the set does the rest for you.

The computer, once connected, checks your terminal to see if it is registered and if all is correct allows you into the data base. The first page of information is page 0 and this represents the bottom level of index. You may have 10 choices but they are very wide in scope. If you pick any one choice you will go to a slightly more precise index and so on. If you keep going you will eventually get to a point where one of the options you are offered is the piece of information you actually require.

At the top right of the screen you will see a number. This will generally increase by a factor of 10 for each step you take down the 'tree'. For example let's go back to our mythical flight on BA. We know that the first page for BA on the system is 313, and the choice offered there for Europe is '1'. If we key '1' we would expect to move down one level in the database and, surprise surprise, we do. We are now at page 3131 and there is a choice of three options. The Eastern Mediterranean, the one we want, is choice '2' and pressing that takes us to page 31312. We now have Athens as choice '4' and pressing '4' will take us to page 313123. Each stage in the process has dropped us one level further down the tree.

The facilities for presenting information on each page; colour, text graphics etc are the same as that available on Teletext and I won't spend time going over the same ground as last month.

More Than Facts And Figures

The sort of information you can get on any Viewdata system need not be limited to just the usual dictionaries and lists of train and plane timetables. These are the real bread and butter of the service and are not to be scorned, but they rarely offer us any technical innovations.

Because the system can get information from the user there is very little to stop the introduction of direct purchasing. In fact, it's already there and you can, for example, order up a case of wine from one part of the data base or book a hotel room on another. The system knows exactly who you are and where you live because this is built into the set, and given that you can key in your credit card number all these facilities are there for the taking.

If you can talk back to the system through one of these response frames there should be very little to stop you talking to another user povided that you know his or her special code. At this point the first draft of the manuscript heads straight for the wastepaper basket because Mailbox, the electronic message service on Prestel, is now up and running.

If, like the majority of users, you only have a numeric keypad, you'll have to use one of the preformatted messages but those with full alpha keyboards can send up to a screenful of message at a time.

At present the service is only available in London and then only on

B7		0	0	0	0	1	1	1	1
B6		0	0	1	1	0	0	1	1
B5		0	1	0	1	0	1	0	1
B4 B3 B2 B1	Col / Row	0	1	2	2a	3	3a	4	4a	5	5a	6	6a	7	7a
0 0 0 0	0	NUL		Sp		0		@	NUL	P	DLE	—		p	
0 0 0 1	1		DC1	!		1		A	ALPHA RED	Q	GRAPHICS RED	a		q	
0 0 1 0	2		DC2	"		2		B	ALPHA GREEN	R	GRAPHICS GREEN	b		r	
0 0 1 1	3		DC3	£		3		C	ALPHA YELLOW	S	GRAPHICS YELLOW	c		s	
0 1 0 0	4		DC4	$		4		D	ALPHA BLUE	T	GRAPHICS BLUE	d		t	
0 1 0 1	5	ENQ		%		5		E	ALPHA MAGENTA	U	GRAPHICS MAGENTA	e		u	
0 1 1 0	6			&		6		F	ALPHA CYAN	V	GRAPHICS CYAN	f		v	
0 1 1 1	7			'		7		G	ALPHA WHITE	W	GRAPHICS WHITE	g		w	
1 0 0 0	8	BS	CANCEL	(		8		H	FLASH	X	CONCEAL	h		x	
1 0 0 1	9	HT		)		9		I	STEADY	Y	CONTIGUOUS GRAPHICS	i		y	
1 0 1 0	10	LF		*		:		J	END BOX	Z	SEPARATED GRAPHICS	j		z	
1 0 1 1	11	VT	ESC	+		;		K	START BOX	←		k		¼	
1 1 0 0	12	FF		,		<		L	NORMAL HEIGHT	½	BLACK BACKGROUND	l		ll	
1 1 0 1	13	CR		—		=		M	DOUBLE HEIGHT	→	NEW BACKGROUND	m		¾	
1 1 1 0	14		CURSOR HOME	.		>		N		↑	HOLD GRAPHICS	n		÷	
1 1 1 1	15			/		?		O		#	RELEASE GRAPHICS	o			

COLUMNS 2a,3a,6a,7a produced after Graphics select code
COLUMNS 4a,5a produced after ESC code

The Viewdata graphics and alphabetic set. You need to know this if you are going to connect your micro to an adaptor such as Tantel.

one of the comupters. A fuller account of the services can be found in the News pages in this issue.

The next logical step in the service is to extend the message capability to all of the computers and this will come when the new Prestel Advanced Network Design Architecture (PANDA) starts up next year.

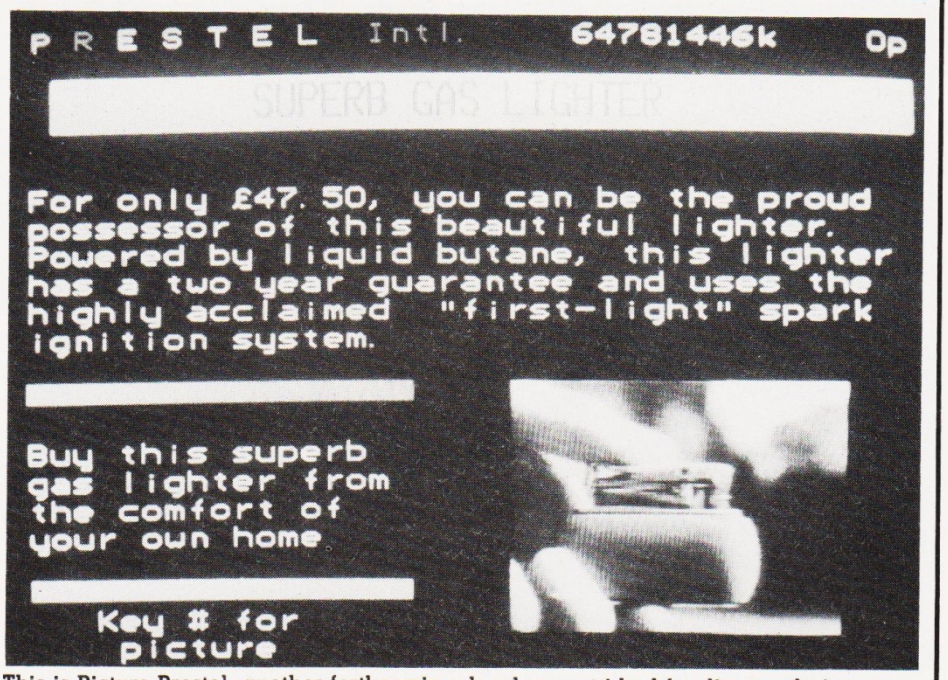
Future Present...

While many people are prepared to publically criticise the whole Prestel operation for its cost, both to the user and the taxpayer, and its apparent slowness in operational advancement it is outside the scope of this feature to join in. Perhaps one should point out that of the four types of Videotex system available anywhere in the world two were invented in this country and the other two are effectively attempts to couple both Teletext and Viewdata type services into one system. These are Telidon in Canada and Antiope in France although one should mention the Japanese CAPTAINS system too for the sake of completeness.

The Viewdata system developed in this country has been sold to West Germany (Bildschirmtext), Hong Kong, The Netherlands, Switzerland, Austria, Italy and Belgium. In addition to this impressive record there is now an international Viewdata network which includes Australia and the USA. Indeed, if you are going to the States next year you will be able to dial your very own Prestel computer which is currently being installed in Boston!

The next stage of the process will occur when the PANDA network becomes established as this allows other data bases to become part of the service. If, for example, you dial up the Central Office of Information on page 500 you are actually accessing information held for them on a BT computer. With PANDA the possibility exists for you to dial that page and access information held on the COI computer. This, in turn, means that instead of using your credit card to buy goods off the system you could, in theory, use your own bank account via your bank's computer. The West Germans already have a similar test system up and running.

The second limitation to the system is the resolution of the graphics. However, a number of trials have taken place with very high resolution graphics and these should be available on the service before the end of the decade.



This is Picture Prestel, another forthcoming development ideal for direct ordering etc.



Our old company logo represented in the current mosaic graphic style.

Further Reading

There seem to be many more books on Viewdata and its various implementations than on Teletext. The ones that I use most often for reference, and would therefore recommend, are;

Viewdata: a public information utility by Dr Adrian Stokes. This is published by Input Two-Nine and offers an excellent technical coverage of both the actual hardware and the methods of frame design.

The Viewdata Revolution by Sam Fedida and Rex Malik. Published by Associated Business Press, this represents what should have been the definitive volume on the subject. Unfortunately in some areas, notable their views on future development, the opinions of the authors seem to differ. The book remains an essential read though for anyone interested in the subject.

The Electronic Bookstall by Rex Winsbury. This little volume was presented to me when I attended a course on Viewdata Editing which was being run by Mills and Allen, one of the biggest umbrella IPs on Prestel. The book is a critique of the first two years of public Prestel operation and is published by the International Institute of Communications. Although now slightly out of date it is well worth reading as it shows up some of the cracks in the facade.

The book I mentioned last month, **Teletext and Viewdata** by Steve Money, is also worth a look but does not really give enough coverage on the latter subject.

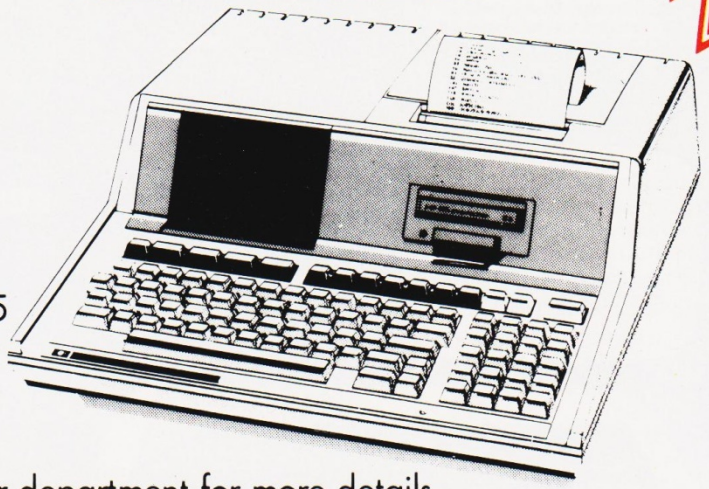
I should stress that these are not the only works on the subject, a comprehensive bibliography can be found at the back of the Fedida/Malik volume, but they do represent the ones I find most useful for finding answers or getting new ideas.

The Next Instalment

These two articles have really only provided a background to the subject of Information Technology but I hope that they have brought to light the two main systems and their functions. Throughout the next 12 months I will be trying to keep you up to date on the various advances made during the Year of IT and the effects that these will have on the public services.

If you have any comments on the subject please feel free to write to the magazine. If there is sufficient interest in any specific topic we'll do our best to produce a feature on it.

HEWLETT PACKARD
HP 85



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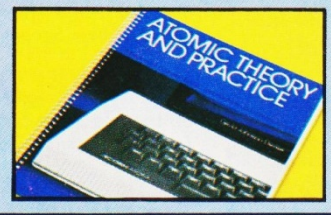

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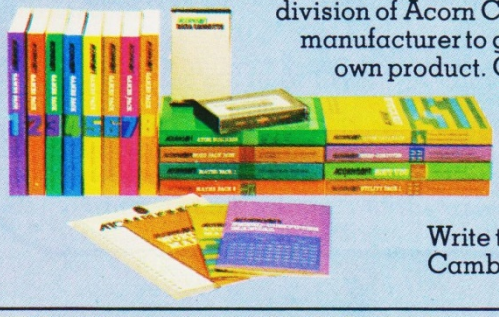

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Each cassette costs £3.95 (including VAT and p&p) and comes complete with full instructions.

Although primarily designed for the Sinclair ZX81, many of the cassettes are suitable for running on a Sinclair ZX80 – if fitted with a replacement 8K BASIC ROM.

Some of the more elaborate programs can be run only on a Sinclair ZX Personal Computer augmented by a 16K-byte add-on RAM pack.

This RAM pack and the replacement ROM are described below. And the description of each cassette makes it clear what hardware is required.

8K BASIC ROM

The 8K BASIC ROM used in the ZX81 is available to ZX80 owners as a drop-in replacement chip. With the exception of animated graphics, all the advanced features of the ZX81 are now available on a ZX80 – including the ability to run much of the Sinclair ZX Software.

The ROM chip comes with a new keyboard template, which can be overlaid on the existing keyboard in minutes, and a new operating manual.

16K-BYTE RAM pack

The 16K-byte RAM pack provides 16-times more memory in one complete module. Compatible with the ZX81 *and* the ZX80, it can be used for program storage or as a database.

The RAM pack simply plugs into the existing expansion port on the rear of a Sinclair ZX Personal Computer.



Cassette 1 – Games

For ZX81 (and ZX80 with 8K BASIC ROM)

ORBIT – your space craft's mission is to pick up a very valuable cargo that's in orbit around a star.

SNIPER – you're surrounded by 40 of the enemy. How quickly can you spot and shoot them when they appear?

METEORS – your starship is cruising through space when you meet a meteor storm. How long can you dodge the deadly danger?

LIFE – J. H. Conway's 'Game of Life' has achieved tremendous popularity in the computing world. Study the life, death and evolution patterns of cells.

WOLFPACK – your naval destroyer is on a submarine hunt. The depth charges are armed, but must be fired with precision.

GOLF – what's your handicap? It's a tricky course but you control the strength of your shots.

Cassette 2 – Junior Education: 7-11-year-olds

For ZX81 with 16K RAM pack

CRASH – simple addition – with the added attraction of a car crash if you get it wrong.

MULTIPLY – long multiplication with five levels of difficulty. If the answer's wrong – the solution is explained.

TRAIN – multiplication tests against the computer. The winner's train reaches the station first.

FRACTIONS – fractions explained at three levels of difficulty. A ten-question test completes the program.

ADDSUB – addition and subtraction with three levels of difficulty. Again, wrong answers are followed by an explanation.

DIVISION – with five levels of difficulty. Mistakes are explained graphically, and a running score is displayed.

SPELLING – up to 500 words over five levels of difficulty. You can even change the words yourself.

Cassette 3 – Business and Household

For ZX81 (and ZX80 with 8K BASIC ROM) with 16K RAM pack

TELEPHONE – set up your own computerised telephone directory and address book. Changes, additions and deletions of up to 50 entries are easy.

NOTE PAD – a powerful, easy-to-run system for storing and retrieving everyday information. Use it as a diary, a catalogue, a reminder system, or a directory.

BANK ACCOUNT – a sophisticated financial recording system with comprehensive documentation. Use it at home to keep track of 'where the money goes,' and at work for expenses, departmental budgets, etc.

Cassette 4 – Games

For ZX81 (and ZX80 with 8K BASIC ROM) and 16K RAM pack

LUNAR LANDING – bring the lunar module down from orbit to a soft landing. You control attitude and orbital direction – but watch the fuel gauge! The screen displays your flight status – digitally and graphically.

TWENTYONE – a dice version of Blackjack.

COMBAT – you're on a suicide space mission. You have only 12 missiles but the aliens have unlimited strength. Can you take 12 of them with you?

SUBSTRIKE – on patrol, your frigate detects a pack of 10 enemy subs. Can you depth-charge them before they torpedo you?

CODEBREAKER – the computer thinks of a 4-digit number which you have to guess in up to 10 tries. The logical approach is best!

MAYDAY – in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

Cassette 5 – Junior Education: 9-11-year-olds

For ZX81 (and ZX80 with 8K BASIC ROM)

MATHS – tests arithmetic with three levels of difficulty, and gives your score out of 10.

BALANCE – tests understanding of levers/fulcrum theory with a series of graphic examples.

VOLUMES – 'yes' or 'no' answers from the computer to a series of cube volume calculations.

AVERAGES – what's the average height of your class? The average shoe size of your family? The average pocket money of your friends? The computer plots a bar chart, and distinguishes MEAN from MEDIAN.

BASES – convert from decimal (base 10) to other bases of your choice in the range 2 to 9.

TEMP – Volumes, temperatures – and their combinations.

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	22	Cassette 2 – Junior Education	£3.95	
	23	Cassette 3 – Business and Household	£3.95	
	24	Cassette 4 – Games	£3.95	
	25	Cassette 5 – Junior Education	£3.95	
	17	*8K BASIC ROM for ZX80	£19.95	
	18	*16K RAM pack for ZX81 and ZX80	£49.95	
		*Post and packing (if applicable)	£2.95	
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COT 12

INDEX '81

what else could it be but our annual index? Cunningly collated, subtly sorted, prettily presented,

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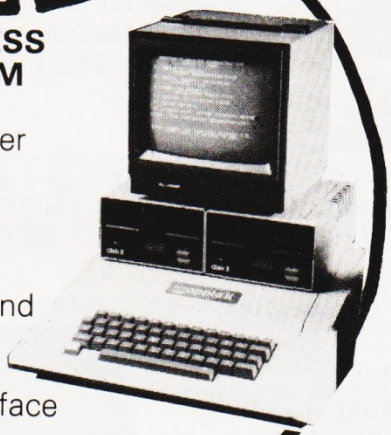

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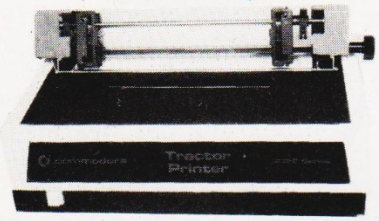

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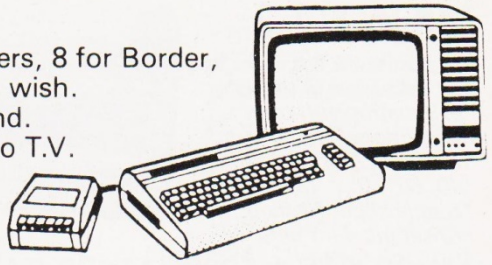

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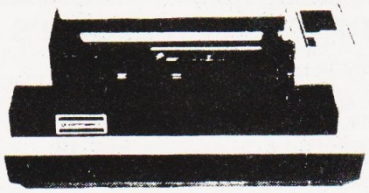


Available soon
VIC Dot Matrix Printer
80 Column, 30 CPS,
Tracter Feed
ONLY £199.95

VIC-MEMORY 3K

LOW COST



Small size — Low cost memory expansion
Plugs into Vic and reproduces memory-port.
Can be used with other expansions.
Gives a total of 6K user static ram on Vic.

£39

FEATURE This board allows Vic to move Basic to begin at 1024 ($0400) as in Pet, and enables the use of **HIGH RESOLUTION COLOUR GRAPHICS.**

VIC TOOLKIT

This may be used with the VIC Rom Switch board.





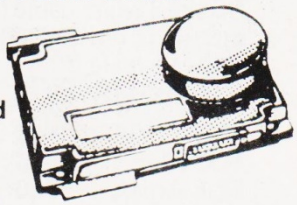
For those who know toolkit on Pet we now have same facilities for VIC.

e.g. Remember, Append, Auto etc.

£25

VIC-RS232 INTERFACE

£49



VIC-RS232 INTERFACE
Fully implemented (true levels)
RS232C-V24
BI-DIRECTIONAL INTERFACE

Allows Vic to work as Mainframe Terminal, Drive a Qume Daisywheel or a Paper Tape Punch etc. etc.

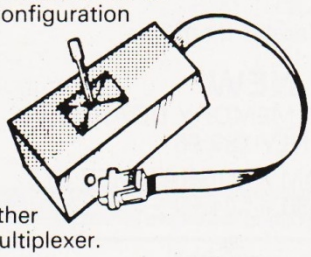
FEATURE
The RS232, fully-implemented interface that we offer contains a master power unit which can double Vics ability to support add-ons and has an external socket to allow the supply voltges plus 5V, plus 15V, -15V to be used for other devices, memory expansions, cassette drives, light pens, printers etc.

VIC JOYSTICK

SINGLE

Hand-held joystick units for games use available in Pair or Single configuration

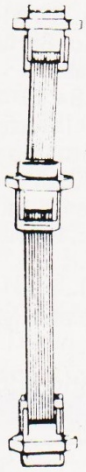
£13 (each)



PAIR

2 Singles will not work together without Multiplexer.

VIC GAMES PORT ADAPTOR CABLE



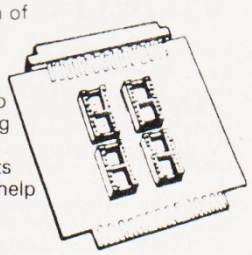
Games Port Plug

A two into one adaptor for use with both joysticks and light pens. A must for those who require full control of games with graphics.

FEATURE
Low-cost
High-quality
— Robust
— Stackable **£17**

VIC ROM SWITCH BOARD

An inexpensive unit which plugs direct onto Memory Expansion Port of the VIC and allows the insertion of up to 4 ROMS for games packs or toolkit aids etc.
Feature Simple software switch exchanges each pair of ROMS into VICS Rom Space allowing clashing Roms to be used.
Feature Plug in Zero Force sockets are available as optional extras to help eliminate pin damage to valuable ROMS.



£35

VIC-LIGHT PEN

ONLY £25



This high quality light pen works in both normal and Hi-Res modes on the Vic allowing simple interaction with the Vic without keyboard entry.

Easy to program and easy to use. e.g. Menu Selection. Non-keyboard entry. Teaching Games.

FEATURE Touch sensitive "Enter" contacts to eliminate accidental entry.

BIDIRECTIONAL RS232 INTERFACE

This unit whilst very low cost does not cut corners in performance but uses true positive and negative data states. The interface is configured as a conventional pin-out to a 25 way 'D'-type connector.

LOW COST

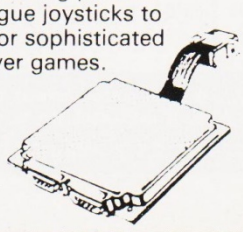
£17



GAMES PORT MULTIPLEXER

This device connects to the games port of the Vic and multiplexes pot x and pot y lines under software control enabling pairs of the analogue joysticks to be used for sophisticated multi-player games.

£33



VIC MEMOR

8K	Prices for these units were not
16K	available at time of going to Press.
24K	Please phone for availability and low cost price.

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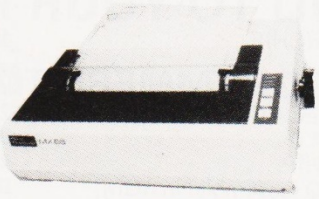
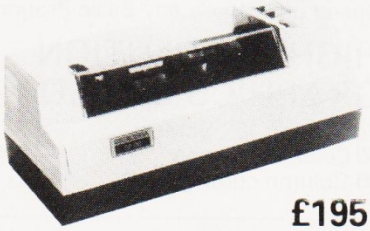


EPSON MX82 £389
AS MX80 plus high resolution graphics.

SEIKOSHA GP80

Probably the world's most compact 80 column Impact Printer

**5x7 dot matrix *128 chrs set inc £ sign *High Res Graphics *30 CPS *80 chrs/line or extended chrs *12 chrs per inch *Tractor feed *Up to 8" plain paper with 3 copies *17.25d x 32.8w x 13.2h cms *2.5Kg*



£195

INTERFACES FOR EPSON'S

Apple Type I inc cable	65
Apple Type II inc cable	85
IEEE interface	45
IEEE — Pet Cable	19
RS232 SK FIFO	98
Standard RS232 interface	45
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RS232 3 whire cable (for 380Z)	15

Interfaces for TRS80 and Sharp also available

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ACCESSORIES

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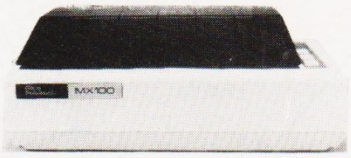

EPSON MX 100 £575
New 15" carriage, high resolution graphics, 254 columns.

UK101

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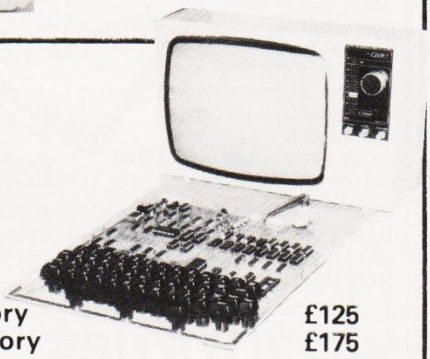

UK 101 Kit **inc. 8K Memory**	£125
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In some cases both a high level language and the processor type are given. In these instances the software will entail the use of both the high level language and the machine code for that system.

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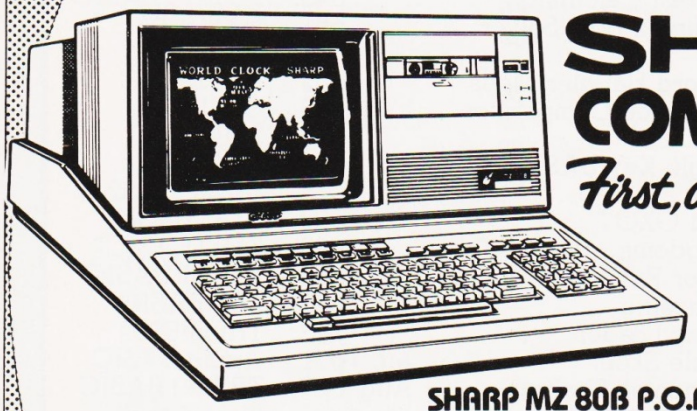
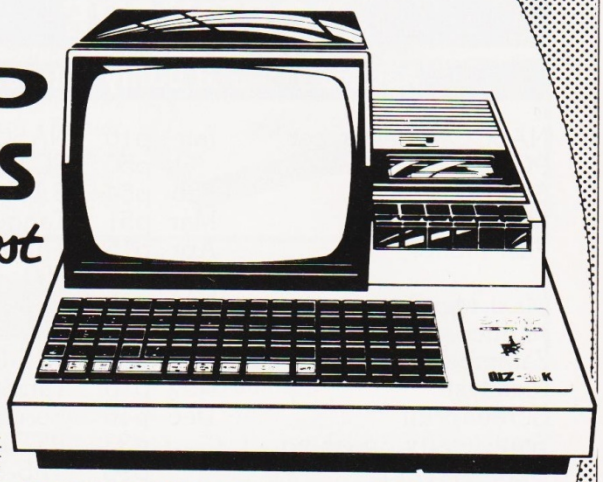


SHARP COMPUTERS

First, and foremost



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SHARP PC 1211 Pocket Comp Sharp PC1211 Pocket computer — Programs in Basic, Qwerty Alphabetic Keyboard, 1.9K Ram, Long battery life with interface £105. **£93.00** Printer for PC1211 **£74.00**

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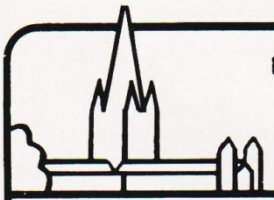

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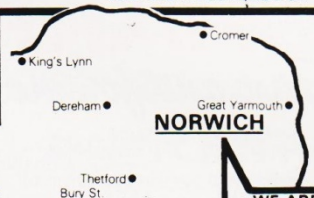

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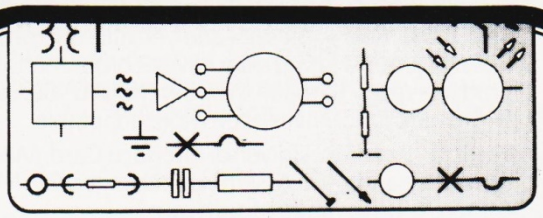

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J Brown and A Stokes

The definitive revelations as to who's using what computer in their schools and how many they've got

A survey was made of all the Local Education Authorities and Metropolitan District Authorities to find out what types of microcomputer are used in schools. The main aim of the survey was to establish the most widely used microcomputer. The survey was conducted with a view to facilitating software exchange systems and other forms of microcomputing liaison.

With these goals in mind a letter was drafted which was sent to all the Local Education Authorities. The letter, which was originally sent to these Authorities only, and later to the Metropolitan District Authorities, asked for the types of machine favoured by the authority and the number in use. The replies came back very slowly but as the replies began to mount it became clear that four main types of microcomputer dominated the schools market.

Getting The Answers

Questionnaire response rate tends to decrease when questionnaire complexity increases. A simple letter request for information gave an excellent response rate (95% for LEA's, and 88% overall) but at the cost of a certain heterogeneity in the form of the information supplied. For example, some authorities gave only approximate figures, while others gave percentages. The replies received varied in the details given of the different types of microcomputers. This made compilation of the data difficult. Tables 1 and 2 were set up, using the four favoured microcomputers as headings, and the data was entered indicating the number of microcomputers purchased by each authority. A separate column was allowed for any other makes purchased and for any comments made by the authority. Some authorities used very general terms such as 'some . . .' or 'we favour . . .'. A number of authorities also gave the details of machines on order, and as much of this information as possible was transferred to the data tables, and the tables are being continually updated. Although 39 Local Education Authorities were contacted only two did not reply and of the Metropolitan District Authorities seven out of 35 did not reply.

Recommendation of certain types of machine by some Local Education Authorities to schools have been the result of studies conducted by the authority. This is not, however, always the reason for standardisation. Table 3 lists all the authorities who have 'standardised', 'recommended', 'approved' etc particular types of microcomputer in their authorities. It should be noted that although the authorities may have 'recommended' or 'standardised' on a particular machine there are other microcomputers in small numbers in their schools. Also, schools that have been allowed to purchase the microcomputer of their own choice have, in general, purchased from the four most popular machines shown in this study. Despite the Department of Industry's policy of paying for half the cost of any Research Machines 380Z or BBC Computer purchased there remains, perhaps surprisingly, a wide range of microcomputers in use.

It was not made clear from the correspondence received how or why many authorities decided to standardise on equipment. Of the 36 authorities who stated a preference for one or more machines six actually

Authorities	380Z	PET	Apple	Tandy	Others/ Comments
Avon	30	2			
Bedfordshire	75%	4			Standardised; other 25% of schools to get 380Zs
Berkshire	55	5			
Buckinghamshire	33	1	1	1	14 380Zs on order
Cambridgeshire	9	39	3	6	1 Horizon, Sinclair, SWTP, 5 Atoms, 17 Challengers
Cheshire	2	12	42	12	
Cleveland	●	●			30-40 machines
Cornwall	8	6			1 Acorn, 2 Sorcerer, SWTP, 3 Horizons, 4 ZX80/81
Cumbria					
Derbyshire	6	37			2 UK 101s, Acorn, Kim
Devon	20	some			
Dorset	16	12			
Durham	●				
East Sussex		32			
Essex	●	●			
Gloucestershire	10	some	some	some	
Hereford & Worcester	29	12			
Hertfordshire	70				Standardised on 380Z's
Humberside					
Isle of Wight	●	●			
Kent	●				
Lancashire	●				
Leicestershire	●				
Lincolnshire	1	17	3		1 Nascom, 5 ZX80s
Norfolk	25+	25+			
North Yorkshire	35	some			
Northamptonshire	34	5	1	2	1 SWTP, Sinclair
Northumberland	2	13	1		2 Nascoms
Nottinghamshire	●			●	NorthStar Horizon
Oxfordshire	●	●			
Shropshire		●			
Somerset	18				Favours the 380Z
Staffordshire	●		●		
Suffolk	12	6		6	
Surrey	15				Favours the 380Z
Warwickshire	●				
West Sussex	1	>40	1		
Wiltshire	50%	25%	25%		
City of Manchester		●			

● = Favours that particular machine

Table 1. County education authorities and the systems that they favour.

Authorities (Met. Dist.)	380Z	PET	Apple	Tandy	Others/ Comments
Bolton	●	●			
Bury					
Oldham					
Rochdale		50-60			
Salford		18			380Zs to go to 6th form colleges
Stockport					
Tameside	2	7			17 380Zs to be acquired by Christmas 1981
Trafford	2	9	1	1	and others
Wigan	8	34			
Knowsley	7	20	2		1 Sinclair, Acorn, Ventek
Liverpool	18	7	4		
St. Helens	8	3	1	5	1 Ventek
Sefton					
Wirral	21				Favours the 380Z (21/29 schools have the 380Z)
Barnsley	20				Favours the 380Z
Doncaster	●				
Rotherham	2	5	8		
Sheffield					
Gateshead	8	25	17	3	2 Sinclairs
Newcastle Upon Tyne	3	19			
North Tyneside	●	some			
South Tyneside		●			
Sunderland		44			
Birmingham	●				
Coventry	6				8 380Zs on order
Dudley	some	22	7	some	
Sandwell					
Solihull					
Walsall				150	
Wolverhampton	20				Favours the 380Z (20/21 schools have the 380Z)
Bradford		●			
Calderdale	6		3	1	14 380Zs applied for
Kirklees	11	6		2	Favours the 380Z; 6 Video Genies, 3 Ohio Scientifics, Sinclair
Leeds	●				
Wakefield	●	some	●	some	

● = Favours that particular machine

Table 2. As Table 1 but for Metropolitan Authorities.

conducted or commisioned studies before making any recommendations. The replies indicate that the results of these studies motivated five of the six authorities to recommend the purchase of RML 380Z microcomputers and the remaining authority to recommend the purchase of the RML 380Z and the Commodore PET. A further breakdown of the authorities who have recommended standardisation is given below.

Microcomputers Recommended	Percentage of Authorities
RML 380Z	52%
PET	19%
RML 380Z and PET	19%
RML 380Z and Apple	3%
RML 380Z, PET and Apple	3%
Tandy	3%

From the beginning of this study it was realised that the information received would be dating before pen touched paper and this is of course inevitable in such a rapidly developing area. Recent reports indicate that schools in Berkshire have purchased the Piccolo microcomputer. Another potentially significant development is the news that the Department of Industry's policy may be illegal under the Treaty of Rome. It is suggested that the policy may in some way 'prevent, restrict or distort competition.' The standardisation of a specific type (or types) of microcomputer by Local Education Authorities has not inhibited schools from purchasing the microcomputer of their choice, especially when private funds are used to buy the equipment.

Our thanks must go to the teachers and children at St Joseph's School, Highgate for inspiring our cover.

Education Authority	Microcomputer
Bedfordshire	RML 380Z
Cleveland	RML 380Z and PET
Devon	RML 380Z
Dorset	RML 380Z and PET
East Sussex	PET
Essex	RML 380Z and PET
Hereford and Worcester	RML 380Z and PET
Hertfordshire	RML 380Z
Isle of Wight	RML 380Z and PET
Kent	RML 380Z
Lancashire	RML 380Z
Leicestershire	RML 380Z
Manchester, City of	PET
Norfolk	RML 380Z and PET
Northamptonshire	RML 380Z
Oxfordshire	RML 380Z
Shropshire	PET
Somerset	RML 380Z
Staffordshire	RML 380Z and Apple
Surrey	RML 380Z
Warwickshire	RML 380Z
West Sussex	PET
Wiltshire	RML 380Z, PET and Apple

Metropolitan Authority	
Bolton	RML 380Z and PET
Barnsley	RML 380Z
Doncaster	RML 380Z
Leeds	RML 380Z
North Tyneside	RML 380Z
Rochdale	PET
St. Helens	RML 380Z
Sunderland	PET
South Tyneside	PET
Wakefield	RML 380Z
Walsall	Tandy
Wirral	RML 380Z
Wolverhampton	RML 380Z

Table 3. The 'league table' of the various Authorities and their main choice of system.

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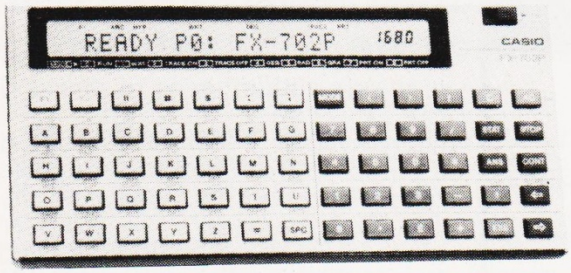

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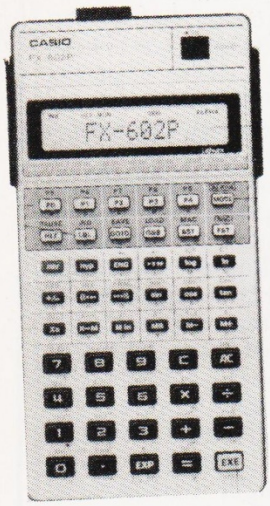

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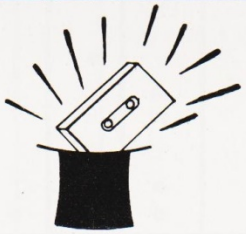

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Before any computer can compute it needs information: we show you how to feed it in

Writing a program for a computer in BASIC is easy — don't let anyone put you off by saying otherwise. Computer buffs may very well say that your program wastes memory, is messy, not very elegant or that you should pay more attention to top down programming structure. Listen and learn from their experience by all means but do not go away feeling your program is useless. In time your programs will become more elegant, better structured and will use less of your valuable memory. The important thing to remember is 'Did your program work?'. If it did you are already on the road to better programming, and if it didn't then these pages will help you get it right next time.

Putting It In

Last month we began to learn the language used by many of the popular microcomputers... BASIC. Like any working language it consists of a number of words to communicate with the computer, and certain elementary rules of grammar that must be followed. As we said last month the actual number of words that the computer will initially recognise is quite limited. So, a little effort on your part should master them fairly quickly. Having started with probably the most commonly used statement, PRINT, which enables you to instruct the computer to display information, we now turn our attention to INPUT which is one way the computer can derive the information that you wish it to PRINT! PRINT!

The INPUT statement allows the entry of data during the execution of a program. This may be in the form of either numerical data for subsequent use in arithmetical formulae or expressions. Or it may be string data such as text or graphic symbols. 'During program execution' means that the INPUT statement may only be used when it is included in a line of a program and may not be used in direct mode. For example, type in PRINT "MY NAME IS TARQUIN" and, on pressing RETURN, the computer will display MY NAME IS TARQUIN. But, if you key in INPUT X and press RETURN you will get an error message of some kind. INPUT must be part of a program, for instance:

```
10 A$ = "YOUR NAME IS "
20 PRINT "WHAT IS YOUR NAME"
30 INPUT N$
40 PRINT A$;N$
50 END
```

On RUNning this program WHAT IS YOUR NAME will be displayed and a question mark (?) will appear on the line below. The program will now wait for you to key in data and then press RETURN. Having typed in FRED the following line will display YOUR NAME IS FRED.

More than one set of data, either numeric or string or both, may be requested with one INPUT statement but each ***must*** be separated by a comma: 30 INPUT N$, Y$, A,B,X. The RETURN key may be pressed after each item of data or after all the items of data have been keyed in, in the latter case each item must be separated by a comma. Also, you must know what type of data is to be expected and use the appropriate symbols:

```
30 INPUT X...expects numeric data
30 INPUT X$...expects string data.
```

You may enter numeric data when requesting a string but you can ***not*** then immediately use this data for any arithmetical operation. This is because the computer expects text or graphic symbols perhaps including numerics. But, because you have stated that the data is a string it deals with it as a block of symbols and if you think about it you cannot ***arithmetically*** add JOHN to 555 or XMAS to PUDDING.

If you enter string data when requesting numeric the computer will display an error message, but will still wait for and accept the correct data. But the most disturbing result of all is if you press RETURN without keying in any data whatsoever. This can result in your program terminating and READY is displayed signalling that the computer is awaiting your instructions. You now have to start RUNning the program all over again, which is quite infuriating if you have got some way into a lengthy program.

Some of these problems can be circumvented by simple program routines and we will look more closely at 'crashproofing' a program later in this series.

Input Prompting

Let us look again at our simple program, it consists of five lines numbered in 10s ie 10, 20,30, 40, 50. Unless instructed to do otherwise the computer will start executing a program from the smallest line number and progress line by line to the largest. Each time it is required to display information it will display that information on the line below any previously displayed information ***unless it is told to do otherwise.*** RUNning the above program will give you the following display:

```
RUN                 type RUN and press RETURN
WHAT IS YOUR NAME
? FRED              type FRED and press RETURN
YOUR NAME IS FRED

READY               computer awaits instruction
```

We have mentioned vocabulary and grammar in association with computer language and have also seen one use of punctuation (the commas between data requests in the INPUT statement). If we now alter line 20 of our program to: 20 PRINT "WHAT IS YOUR NAME"; the computer will understand this use of the semicolon to mean that it must display any following information immediately after what it has just PRINTed. This means that instead of the prompt for INPUT (the?) appearing on the next line you will now see displayed:

```
WHAT IS YOUR NAME? ■
```

The cursor (■) indicates where the data will be displayed as you type it in. This is often visually more acceptable than having the prompt apparing on a separate line. A similar effect will occur if you were to use a comma but now the prompt will appear a fixed number of spaces to the right of the text:

```
WHAT IS YOUR NAME     ? ■
```

An INPUT statement may also have the effect of a PRINT statement. If we alter our program to:

```
10 A$ = "YOUR NAME IS "
20 INPUT "WHAT IS YOUR NAME";N$
40 PRINT A$;N$
50 END
```

This will display:

```
WHAT IS YOUR NAME? FRED
YOUR NAME IS FRED
```

On some computers the semi-colon has to be replaced with an alternative separator, ***check your manual to see which your BASIC requires.***

An Alternative Approach

Let us consider the following program:

```
10 INPUT "WHAT IS YOUR SURNAME";A$
20 INPUT "WHAT IS YOUR FIRST NAME";B$
30 PRINT B$;A$
40 END
```

On the prompt for surname you key in SMITH and for first name JOHN. Displayed on the screen in response to line 30 will be JOHNSMITH Using the old grey matter you RUN the program again keying in a space before SMITH. Unfortunately this still results in JOHNSMITH so perhaps you try a space after JOHN. No luck the computer ignores blank spaces at the beginning and end of strings. Also, if you have text that includes a comma (,) or a colon (:) the data up to these punctuation marks is accepted and that after is ignored and an error message displayed. Remember that to enter more than one set of data the data was separated with a comma and here we have stated INPUT A$ therefore only one data string is expected. These problems can generally be resolved quite simply by enclosing the data within quotation marks (") so:

```
WHAT IS YOUR SURNAME? " SMITH"
WHAT IS YOUR FIRST NAME? JOHN
JOHN SMITH
```

Incidentally the above example of JOHNSMITH can be solved another way — the clues are there . . . The answer is not very practical but think about it.

So much for string INPUTs, how about numeric INPUTs. An example of a program involving these could be:

```
10 PRINT "ENTER SIX NUMBERS"
20 INPUT A,B,C,D,E,F
30 S=A+B+C+D+E+F
40 PRINT
50 PRINT "THE SUM = ";S
60 PRINT
70 PRINT "THE AVERAGE VALUE = ";S/6
80 END
```

The purpose of the program should be self-explanatory but there are a couple of points to note . . . line 30 has assigned S equal to the sum of the six numbers, this has saved us having to type in A+B+C+D+E+F both in lines 50 and 70. I hate to have to say it but this sort of laziness is something to be encouraged!

The reason for the PRINT in lines 40 and 60 is simply to instruct the computer to print a blank line, so making the display easier to read. Talking of line numbers the reason programs are written with line numbers 10,20,30,40, etc and not 1,2,3,4, is so that you may add instructions to an existing program without renumbering all the lines!

Tail End

We are not offering any prizes for your suggestions on what instruction words will appear next month but it would be interesting to hear in what order you think they should be presented.

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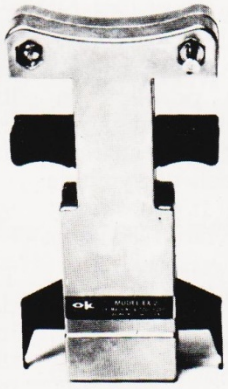

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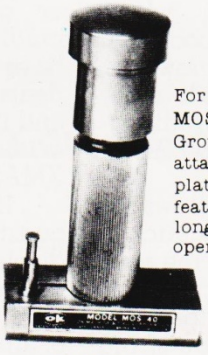

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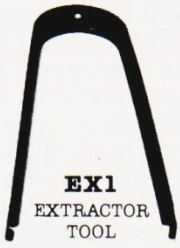

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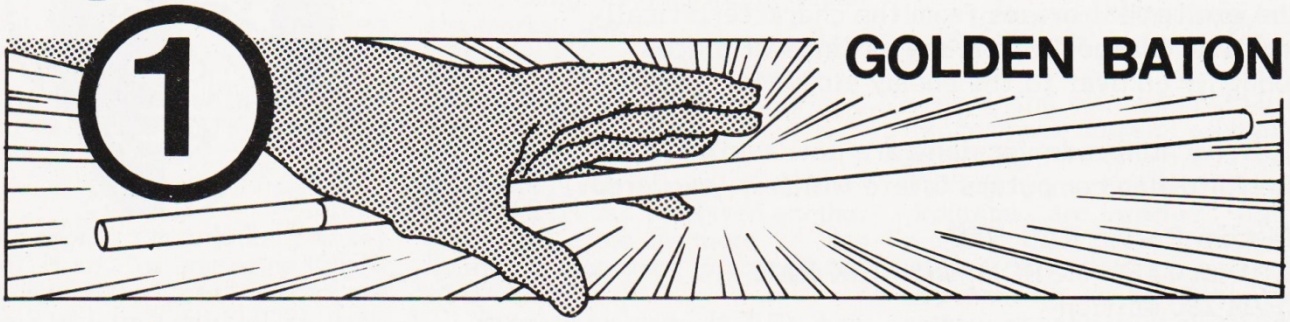

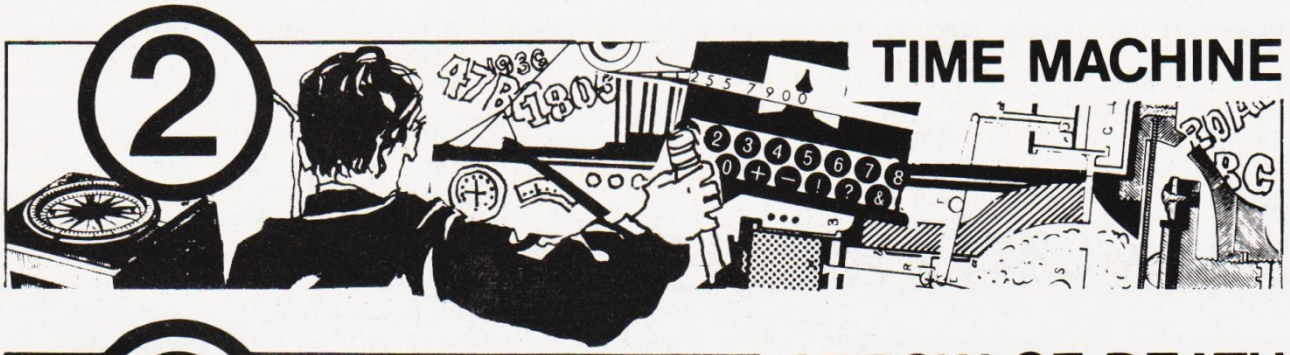

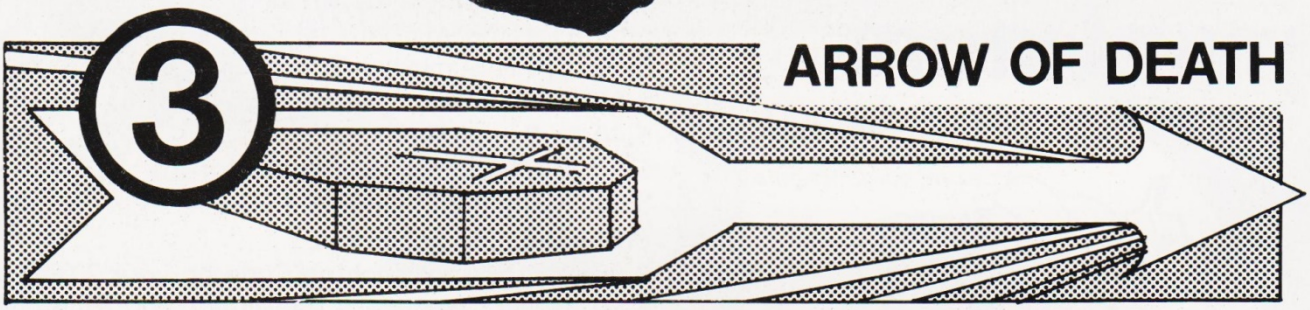

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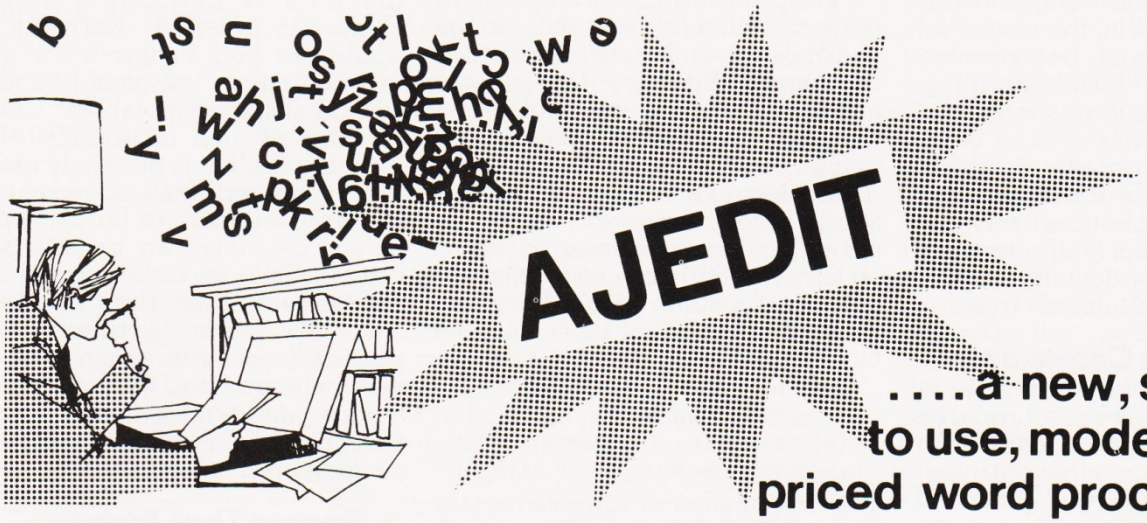

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Store more of your data on cassette with these compact routines

Most articles and books seem to treat the subject of cassette data files very casually, assuming that any serious users must be into disc operations anyhow. This isn't necessarily the case, and this article aims to look at the neglected subject of making the best possible use of cassettes for data filing, particularly where large amounts of data are concerned.

The system on which these routines have been developed is a TRS-80 but it is more than likely that your cassette system is structured in the same way, particularly if your BASIC is the 12K Microsoft type.

The System Constraints

The fundamental data storage command is PRINT#−1, followed by the appropriate variable name which may be numeric or string in type. Each time the PRINT#−1 command is encountered in a program the cassette motor is started, a leader of 255 bytes of synchronisation pulses recorded, then the data, checksum and filename followed by a trailer of one byte. Even if the data consists of just one number the same procedure is followed and if the PRINT#−1 command is placed in a loop the result will be a number of separate recordings equal to the number of loops performed.

Life would be considerably easier if we could write:

```
PRINT#−1,FOR Z=1 TO 20;L$(Z):NEXT
```

but we can't, even if 20 of the strings would fit comfortably in the 248 bytes (or so) that are allowed in each burst of recording.

Ways Round

For these reasons alone it is worth spending some time looking for alternatives to this method, both for packing and unpacking data from tape.

The simplest packing routine depends on the use of multiple variables after the PRINT#−1 command. If we write:

```
450 PRINT#−1,L$(1),L$(2),L$(3),
    L$(4),L$(5)
```

then all five strings will be recorded in the one burst provided their length does not exceed the 248 byte limit.

This is quite adequate provided you know the length of the strings and can be sure that they will not exceed the limit. Variables can, of course, be mixed but when you recover them from the tape with the INPUT#−1 command you must ensure that the type order is maintained or errors will occur.

The problems start to arise when a large quantity of data has to be recorded and subsequently recovered because the simple method given above does not always represent the most efficient way of going about the task. Life is easy if the data comes in a standard form: take strings of 12 characters in length, for example. If these were arranged as an array, L$(n) and each element contained a string of 12 characters we could pack 20 of them into one burst of recording:

```
100 T$="":FOR J=1 TO n STEP
    20:FOR Z=0 TO 19
110 T$=T$+L$(J+Z):NEXT
    Z:PRINT#−1,T$:T$="":NEXT J
```

The total number of variable items is represented by n in the above example. Using this technique you can pack five minutes of tape with a very impressive number of bytes of information; five seconds per 240 byte burst giving a total of 2880 bytes per minute or 14K in five minutes.

To actually unscramble all this information the subroutine given in Listing 1 is needed. This replays the tape using the INPUT#−1 command and uses the MID$ string operator to separate out the 12 character groups from the complete string. There are several ways of terminating the playback which avoid the normal error message which results from reading nothing.

The first is to actually PRINT#−1,n in line 480 so that the routine knows how many sets of characters it is supposed to read. An alternative is to detect a null string and use that as the terminator, as has been done in Listing 1. The third method is to use the built-in error trapping routines of the TRS-80 to force the program out of the INPUT loop when an 'out of data' error occurs.

How Long...?

The really thorny problem, however, is when strings of undetermined length have to be recorded and replayed. Data such as names and addresses won't always conform to a convenient 12 characters per string format, yet we already know how wasteful it is to use one variable at a time. There are three possible solutions to this problem, all of which I use on a regular basis.

The first is to pad out all the data to a standard length. As long as the data does not vary too widely this is a reasonably acceptable technique and Listing 2 gives a routine which will pad to a length of 20 given that the data is between 8 and 20 characters in length. Normally, we would not pad strings which vary quite so much, between 12 and 20 would be more acceptable.

One of the failures of this technique is that is generally results in ragged printing so some de-padding will have to be performed before the data can be sent to a printer. This can be performed by a routine such as that shown in Listing 3: it's slow, but so are printers! When you are faced with strings that can vary between 1 and 50 characters in length, padding is no longer a viable solution and another method of packing must be sought.

Spaces That Aren't

One of the alternatives which can be usefully employed is code 128. On the TRS-80 this produces a space but it is not identical to the ASCII 32 space that the keyboard produces. This character is often available and a look through the graphics set of your system should reveal one — try Graphic Details last month if you are unsure of the codes. As shown in Listing 4 this character can be identified as a separate entity and is used as a delimiter between strings.

In order to check that the string you're about to add onto the block will not cause the total number of bytes to exceed the set maximum of 240, we must incorporate the look-ahead routine in line 570. As long as the length does not exceed 240 we continue packing, if it would exceed on adding the next string we stop, record the block of data, zero the byte count and start again.

The packing speed is fairly fast but the corresponding unpacker, Listing 5, is not owing to the fact that each character in turn has to be inspected to see if it is CHR$(128). If the data is being printed as it is being unpacked then this delay is of less importance.

The Ultimate Packer?

My 'best' solution to the problem is to use a slightly lower packing density which increases the recovery speed. The packing routine in Listing 6 finds the total length of each string with the LEN() function and then

packs the data string with the string and its length. For machines which have the VARPTR function, like the TRS-80, the use of PEEK (VARPTR(L$(n)) provides the same information as the LEN() function. The data string will now look something like:

15S.R.SMITH 1042719P.J.ROBERTSON
512069C.O.JONES etc . . .

Note that the single figure values of length have been padded out to two places by using RIGHT$ ("00"+STR$(L),3). As before, the total string length is monitored before concatenation to ensure that the target of 240 bytes is not exceeded.

Recovering the data from this kind of packing is performed by a routine like that of Listing 7. The first two characters of the string give the length of the first sub-string in the block and from this the starting point of the next string length can be found. Both the packing and unpacking routines are quite fast, even on a standard machine; adding the speed-up package and Southern Software's ACCEL program will make them very fast indeed.

It is worth noting, however, one point which seldom seems to be made in print which is that the speed of any string handling routine varies according to the number of strings used. Each time a string is declared, even if it is being nulled, a new string space is prepared and the computer has to re-organise its variable storage area. When the reserved string space is very small the delays caused by this memory management, or garbage collection as it is often called, routine can be very large. On a recent test a recording of 300 strings took nearly two hours simply because of the time taken by the management routine.

The only way out of this predicament is to make sure that the memory areas used are not too full. This can be done by recording a set of number of strings and then re-running the program or simply by CLEARing the variable areas. Pauses caused by the management routines can be easily detected, they don't respond to the Break key!

In Conclusion

If you are not yet disc-based then you can at least take heart, there's still some life left in the old data cassette yet. Indeed, bulk storage is much better handled by tape than disc especially long lists that are simply processed sequentially. The floppy disc also has rivals in devices such as the Stringy Floppy which has been reviewed in this magazine in recent months.

Obviously the speed and efficiency of all these routines is limited by the operating speed of the computer and the storage speed of the cassette system. If time is critical one can always revert to machine code routines for the packing and unpacking of the data.

```
490  P=0
500  INPUT#-1,T$:IF T$="" THEN 560
510  FOR J=1 TO 20
520  L$(P)=MID$(T$,12*N-11,12)
530  P=P+1
540  NEXT J
550  GOTO 500
560  REM**REMAINING PROGRAM
```

Listing 1. The simplest 'unpacker' using strings of standard length.

```
100  T$=""
110  FOR K=1 TO N STEP 12
120  FOR J=0 TO 11
130  L$=RIGHT$(STRING$(12,32)+L$(K+J),20)
140  T$=T$+L$
150  NEXT J
160  PRINT#-1,T$
170  T$=""
180  NEXT K
```

Listing 2. A routine to create strings of a fixed length and pack them onto the tape.

```
100  FOR H=1 TO LEN(L$(N))
110  IF ASC(MID$(L$(N),H,1))=32 THEN NEXT
     ELSE LPRINT TAB(10) RIGHT$(L$(N),
     LEN(L$(N))-4)
```

Listing 3. The output from the 'unpacker' will need to be formatted before printing or display.

```
500  CLS:PRINT "PREPARE A CASSETTE OF
     SUITABLE LENGTH FOR A DATA FILE"
510  PRINT "NOTE THE START POINT ON THE
     COUNTER, PRESS PLAY AND RECORD"
520  PRINT "PRESS ENTER WHEN READY"
530  INPUT X:CLS:PRINT TAB(21)"PLEASE WAIT"
540  PRINT#-1,I
550  A$="[SPC]"
560  FOR N=1 TO I:A$=A$+L$(N)+CHR$(128)
570  IF LEN(A$)+LEN(L$(N+1))<245 THEN 590
580  PRINT#-1,A$:A$="[SPC]"
590  NEXT N:PRINT#-1,A$
600  CLS:PRINT "RECORDING FINISHED. PRESS
     ENTER TO RETURN TO MENU"
```

Listing 4. Using a special code to separate the items in each block.

```
620  CLS:PRINT@336,"PREPARE THE INDEX TAPE
     TO REPLAY"
630  PRINT TAB(13)"PRESS PLAY KEY. WHEN
     READY PRESS ENTER"
640  INPUT X:CLS:PRINT TAB(19)"ENTERING
     DATA, PLEASE WAIT":X=1
650  INPUT#-1,I:REM**I IS THE MAX NUMBER
660  INPUT#-1,A$:FOR N=1 TO 245:
     B$=MID$(A$,N,1)
670  IF B$<>CHR$(128) THEN L$(X)=L$(X)+B$:
     GOTO 690
680  X=X+1
690  NEXT N:IF X<I THEN GOTO 660
700  CLS:PRINT TAB(26)"DATA ENTERED"
```

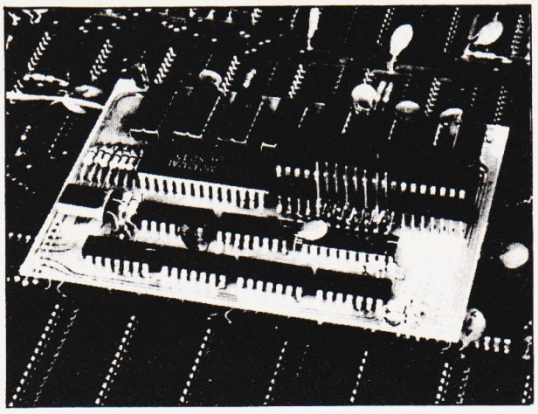
Listing 5. The corresponding 'unpacker' for the routine above.

```
7000  CLS:T$="":PRINT@340,"RECORDING, PLEASE
      WAIT":PRINT TAB(20) STRING$(22,95):
      PRINT#-1,B$,S,R,TT
7010  FOR X=1 TO R:Q$(X)="[2 SPC]"+Q$(X):
      Q$(X)=RIGHT$(Q$(X),3):L=LEN(L$(X))+3:
      C$=RIGHT$("00"+STR$(L),3):
      T$=T$+C$+L$(X)+Q$(X):IF LEN(T$)+
      LEN(L$(X+1))<240 THEN NEXT
7020  PRINT#-1,T$:IF X<R THEN T$="":NEXT
7030  CLS:PRINT@329,"RECORDING COMPLETE,
      PRESS ANY KEY TO CONTINUE"
```

Listing 6. This routine gives the best overall performance for general use.

```
3000  CLS:PRINT@347,"REPLAY TAPE":PRINT
      TAB(27) STRING$(11,35):PRINT:PRINT
      TAB(15)"PREPARE CASSETTE AND PRESS
      PLAY":PRINT TAB(15);:INPUT"PLEASE
      ENTER CLASS DESIGNATION";BB$:N=1:
      Z=1:Y=0
3010  INPUT#-1,B$,S,R,TT:IF BB$<>B$ THEN
      F$="WRONG TAPE":GOSUB 1500:GOTO 40
3020  INPUT#-1,T$
3030  L=VAL(MID$(T$,Z,3)):L$(N)=MID$(T$,3+Z,
      L-3):Q$(N)=MID$(T$,Z+L,3):Z=Z+L+3:
      N=N+1:IF N<=R AND Z<LEN(T$) THEN GOTO
      3030 ELSE IF N<R THEN T$="":Z=1:
      GOTO 3020
```

Listing 7. A typical program segment for recovering data packed by the routine above.



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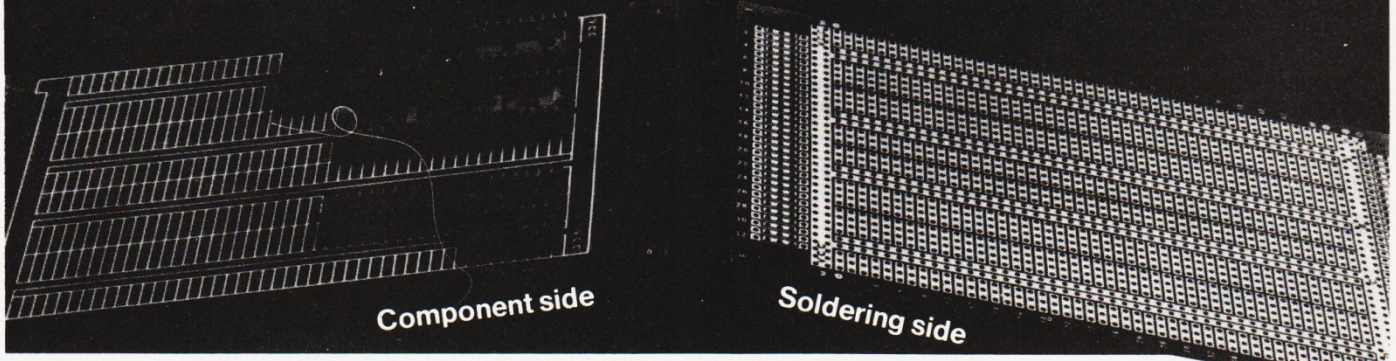

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Questions, answers and a whole lot more in the monthly equivalent of Dr Finlay's Casebook!

Welcome, once again, to this quiet backwater in the magazine where you can, with a little bit of luck, have your problems solved.

High on the list this month is a typical problem that I can't actually do anything about. One of the most common enquiries we get (usually without the obligatory SAE) goes along the lines of:

I would like to invest in a personal computer to help run my home business but I don't know which to buy. I have at most £250 so I have been looking at the following systems (at this point the author of the letter lists everything under that price). Please can you help me choose one.

The answer, I'm afraid, in virtually every single case is NO. Why, you may ask, are we so heartless? If the the truth be told the basic reason is simple — nobody bothers to tell us what they want the system to do, how they want it done, what storage facilities they want etc, etc. Even if they did supply this information the best that we could do is provide a shortlist, something that they could acquire equally well for themselves.

Please don't take this as an offer to help if you do supply the information!

What we will continue to do is to publish reviews and Buyer's Guides and articles explaining how to make your choice the best choice, just as we've always done.

The ZX Syndrome

The second most common question is an enquiry about some aspect of the Sinclair Research ZX81. In general I can answer the enquiries, but many of them require the services of experts. What, goes up the cry, aren't you supposed to be an expert? The experts to whom I refer are the two clubs dedicated to serving the users of the ZX81 and they are the people to whom many of the enquiries I get are re-directed. They are: The National ZX80 and ZX81 Users' Club, 44-46 Earls Court Road, London W8 6EJ and the ZX80 Users' Club, PO Box 159, Kingston-upon-Thames, Surrey KT2 5UQ. The first of these is run by Tim Hartnell who has probably done more for the ZX80 and '81 than most of the rest of the known universe put together and membership of that will cost you £8.50 assuming you live in the UK. The latter group has been somewhat silent of late — perhaps David Blagden might like to remind me of his continued existence?

The Serious Stuff

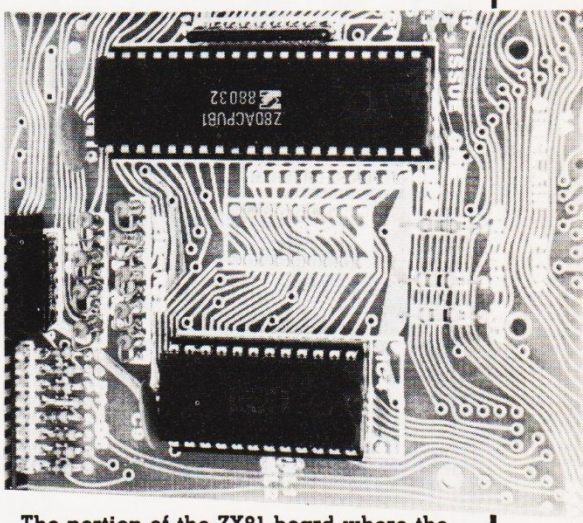
A distraught Apple owner from Pinner recently wrote asking:

I am writing a machine language program for the Apple which requires data to be recorded on tape. I have tried a JSR to FECD which seems to produce the desired effect but I have been unable to find the locations for saving the 'start' and 'end' addresses. Please can you supply the missing information for this and its equivalent READ subroutine.

Ah, er, umm...Like most Apple owners I too have the wonderful manual that gives you the complete System Monitor listing, which is more than many of them do, *but* although they list all the system variables and their Page Zero addresses they don't actually tell you what they do. So, a quick phone call to our local, friendly Apple expert (yes, that's you Ian!) down at Blue Chip Software brought forth the answer that the locations you require are A1L, A1H, A2L and A2H. These reside at 3C, 3D, 3E and 3F Hex respectively and represent the address of the first and last bytes in the data to be stored. The corresponding READ routine lives down the page a piece at FEFD Hex and uses the same two system variables. Ian also suggested that you get in touch with BASUG, the British Apple Systems Users' Group who, according to my files reside with John Sharp at 20 Glebe, Garston, Watford, Herts WD2 6LR. The other alternative is to invest in a publication called **The Apple Monitors Peeled** by William E Dougherty which, I understand, is an Apple-approved book.

A Pinch Of Salt?

There's a lot more to chippery than just adding vinegar it seems! One reader tried to carry out the modification to his ZX81 that T J Cartwright suggested in our August issue. Frustrated in the attempt, he writes:



The portion of the ZX81 board where the memory resides offers expansion to 2K if you're careful.

In response to T J Cartwright's letter I went out to buy a Hitachi HM6116 2K by 8 static RAM to fit into my ZX81. When I got to my local components shop I found that more information is required, specifically access time and standby current, as there are no less than four ICs in Hitachi's range with this reference.

Could you please enlighten me?

A swift telephone call to S of C revealed that they actually recommend the Mostek 4802 device, specifically the 4802-3 which is a 200nS device. If you are going to use the Hitachi equivalent then you want the nearest to that access time. Don't forget to change those links over, too.

In The Bag

Judging by the response that I've had so far this page certainly seems to be a welcome addition to the magazine. The drawers of my filing cabinet are already bulging with letters — keep them coming, and I'll continue to select the most interesting and topical comments for publication.

For those of you who have possibly wondered about the title of the article I shall merely quote an ISBN, 0 408 00135 6, and leave the detective work up to you for a change!

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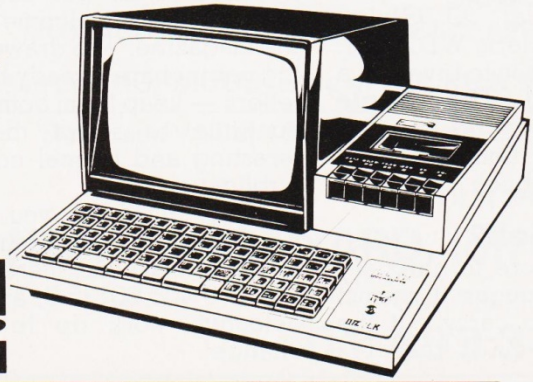

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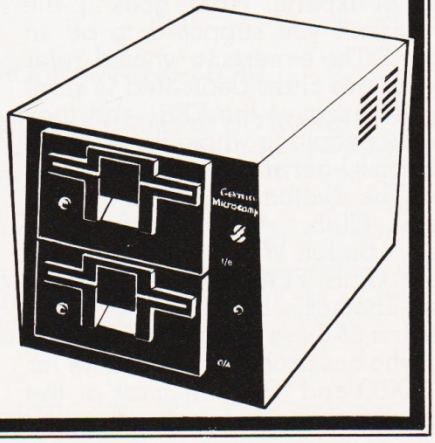

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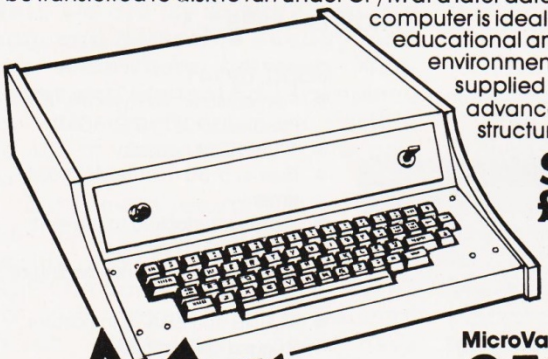

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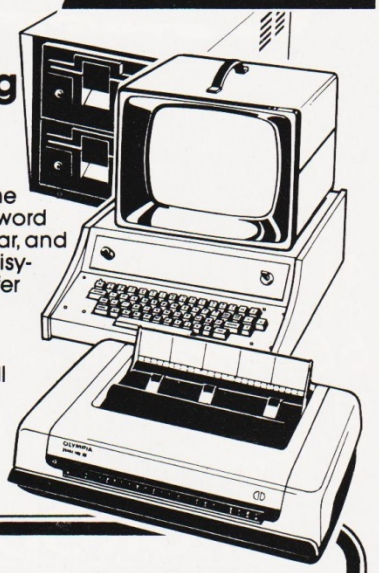

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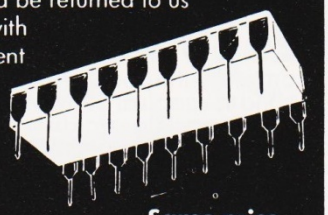

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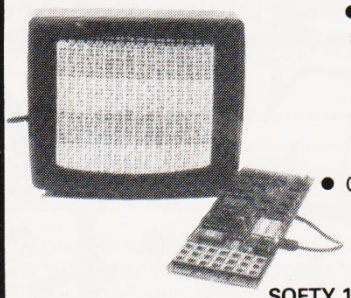

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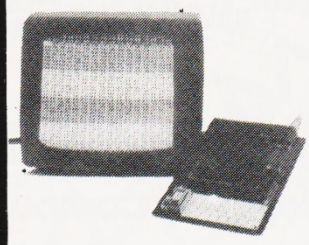

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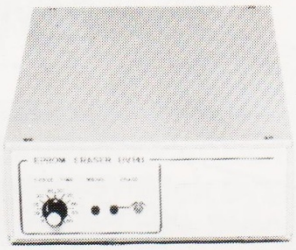

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K-DOS

Paul Kriwaczek

If you don't like your DOS then why don't you change it? We show you how the basics of a very useable system can be built from a commercial starter

It all began when I threw the CP/M master disc at the cat, kicked the computer and swore that as long as I was not an industry I would have nothing more to do with industry standard operating systems. That is not to say that I actually wanted to go back to keeping my programs and data on cassette, but when I went in for a CP/M disc system, I was told about the convenience, the speed, and the masses of cheap software — nobody told me of the convenience of having to reconfigure the memory map of my NASCOM completely, the speed of having to move every program loaded from disc from 0100 Hex to its final position, the cheapness of swapping Microsoft BASIC in ROM and NAS-SYS (one of the best operating systems on a micro) for a crude monitor, designed for a different processor and an antique BASIC compiler with no editor. **(Well, we did try to warn you one damp and miserable Sunday morning somewhere between Manchester and Euston! Ed.)** To replace this with something more flexible and up to date was going to cost nearly £200.

But if not a return to tape, what then? At the time, there wasn't a disc-file system available for the NASCOM apart from the one which had just driven me to attempt felicide. Since then, others have developed, DCS-DOS and NAS-DOS, but then the only possibility left was a pair of EPROMs called D-DOS: a simple piece of firmware containing routines to write a named section of memory to a named position on the disc, to read a given section of the disc to a given place in memory, and to prepare a fresh disc to a standard format. This offered promise, but it soon became clear that the bureaucratic discipline needed to keep track of what was recorded where and in which memory address it belonged was beyond my resources.

Elementary...

In computing, as in detective work, once you have eliminated the impossible, the merely improbable should be given due consideration. So although I would never have had the gall to propose writing my own disc operating system, I thought it might just be possible to implement at least a few simple routines for putting named files into known positions. As so often happens, it turns out to be hardly any more difficult to write a proper piece of software than to cobble something together and the result was K-DOS for NASCOM, a simple disc operating system using D-DOS primitives.

A floppy disc is really no more than a number of pieces of magnetic tape masquerading as a gramophone record, the tapes winding themselves up into concentric rings called tracks which revolve round a central spindle. By moving a record/playback head along the radius of the disc, any part of the magnetic surface can be accessed with minimal delay. One complete track can hold more than 2K bytes, so it is divided into a number of arcs like slices of pie, and these sectors are the minimum unit of disc which the operating system recognises. D-DOS, for example, expects a disc to have 35 tracks per side of disc, and 18 sectors per track.

On the soft sectored discs used in the Gemini drives on my system, the tracks and sectors are not physically present. The drive can detect the disc's angular position by means of a hole punched near the centre, and the subdivisions are placed on it by recording a data pattern which the drive subsequently uses to locate the tracks and sectors. This process is called FORMATTING and luckily all the routines for doing it are contained in D-DOS and the user need not know any more about it than to run the FORMAT routine before using a fresh disc.

D-DOS expects to be given the command F for formatting, R for reading from the disc and W for writing to the disc. When reading, it requires to be told the number of sectors to read, the starting track and sector number and the address to which to load the resulting bytes. When writing, it needs the start and finish address of the section of RAM concerned, and the number of the track and sector to which to start recording. Very straightforward in fact, so just to add a little spice, it uses a disc format — IBM's I believe — which numbers tracks from 0 but sectors from 1!

The Basic Requirements

The kind of DOS most appropriate for a personal system, is not very elaborate. First, it should select from between a number of available disc drives. It needs to be able to store files on the disc by name and retrieve them, erase them, change their names and display an index of the files already recorded. It should be able to work out the start and finish addresses of source files for BASIC and any other firmware installed in the system and as a default, prompt for the needed information. It should also have an option by which files can be loaded and run from a single command. These functions can be summarised like this:

User Input. A module which receives the user's commands, decodes them, stores the file name and any parameters entered with the command and finally passes control to the appropriate function. The module also allows for a controlled exit from the DOS.

Function 1. A routine which displays the names of all files present on the disc and the amount of free space left for use.

Function 2. A routine which locates the named file and loads it into RAM, at an address which it derives from an index somewhere on the disc.

Function 3. A routine which saves the file somewhere on the disc using parameters either explicitly stated in the command or derived from some form of identifier in the file name itself. The routine must also keep a record of what it has done in the disc index.

Function 4. A routine which erases the file in some way and adds to the free space on the disc.

Function 5. A routine which renames the given file.

Function 6. A routine which first reads the named file to RAM and then jumps to a predetermined address to run automatically.

The user input module should be an infinite loop which waits for a command, executes the function by calling a subroutine, and then waits for the next instruction. Each function is itself a block which calls other subroutines in the course of its ac-

tivity. In accord with the precepts of top-down programming, the overall structure of the DOS and the function subroutines as well as some of the routines that they in turn call, can and should be designed and defined without writing a single line of code; it is only when getting down to the very lowest level that the assembler is brought into play. But before that can be done there are a number of major decisions still to be made.

Storage Methods

The first question to be answered when developing a disc file system is, what exactly do we mean by a disc file? If we use the word 'file' to mean any continuous block of bytes, program or data, is it to be stored on disc as a continuous block of sectors or can we distribute the sections of the file over the surface of the disc using the most conveniently available space?

There are in fact three commonly used methods. We can record the files in continuous blocks on the disc, one after another, and keep an index of the length of each file and the track and sector number from which it starts. We can distribute individual sectors over the surface of the disc and treat each file as a linked list, every sector containing a pointer to the start of the next and only the address of the first being kept in the index. Or we can do as CP/M does and, while recording the sectors discontinuously wherever convenient, keep in the index a map of the whole disc and the whereabouts of every sector of every file.

The first method is the simplest to implement and allows for fast retrieval, as each file is all together in one block. It is also easy to find the address of sectors other than the first, thus allowing for random access. But there is a drawback. To erase a file you simply remove it from the index. But you are then left with a gap which may be too large or too small for the next file you wish to save. Either way, there is likely to be a waste of space on the disc, and after many erasures, the disc may end up with as many 'holes' as a piece of Swiss cheese. Every now and again it becomes necessary to get rid of the gaps by moving all the remaining files up. The routine to do this is often called COMPACT, COMPRESS or SQUASH and is an inconvenient necessity which must be part of the system.

No such problem arises with the linked list method. To remove a file, one simply adds the redundant sectors to the free disc space list, ready to be used again. But reading from the disc is much slower because there may need to be substantial movement of the read/write head from one sector of the file to another, which also results in increased wear and tear, and random access is particularly difficult as each sector has to be loaded to memory to find the pointer which indicates where the next sector is to be found. A good compromise is the third method, using a bit-map of the disc. There is still considerable movement of the head, but sectors can be kept reasonably close to each other and random access is not difficult to arrange. The penalty for using this system, however, is its complexity and the amount of disc space used up by the index.

K-DOS, therefore, records its files sequentially on the disc, recording the number of sectors and disc start addresses in the index. But compaction is done every time a file is erased, so that no gaps are left to waste valuable space.

How Long...

Having decided the way in which the files are to be written to the disc the next question is, what size shall the index be? Suppose we intend to read the DOS off the disc itself before starting, rather than keeping the whole thing in ROM — how much of the disc can we afford to use for the system and its file index? Not having written the code at this point, the length of the program is a matter of guesswork but it would be convenient if it ran to about 0700 Hex bytes or 14 disc sectors, because this would leave four sectors — 0200 Hex bytes — for the index, the two together filling all 18 sectors of the first track of the disc. How many entries can we accommodate in 200 Hex bytes? It depends on the length of each entry. How long is each entry? That depends on what information we wish to keep in the index and the maximum permitted length of the filenames. Decisions, decisions, decisions!

What information must be kept in the index? The name of the file, of course; the track and sector numbers where it begins; the number of sectors it occupies; the address to which it should be loaded in RAM; and the address at which execution should start. If the maximum length of the filename is 9 bytes, each entry will occupy 16 bytes, quite a convenient number.

INDEX +0	File name	9 bytes
+9	RAM address	2 bytes
+11	Exec address	2 bytes
+13	No of sectors	1 byte
+14	Track no of start	1 byte
+15	Sector no. of start	1 byte
+16	Start of the next entry	

But we cannot fill the entire index with file data, since we also need to store information about the current vital statistics of the disc. The system has to keep a record of the address of the first free track and sector so as to know where to write the next file, the first free position in the index so as to know where to store the file's details, the number of files stored so as to know when the index is full, the number of free sectors left so as to know when the disc is full, and finally a pair of code bytes which the DOS can test to see whether there is a properly initialised index on the disc. If we allow for a maximum of 30 files, this will leave us with enough room left out of the 512 bytes (200 Hex) to store this information.

Once we have set aside a section of memory to store the disc index while we consult it or alter it, and another block of bytes to use as a buffer, we will be ready to start designing the individual routines. When we enter a command it appears on the screen, and NAS-SYS keeps a pointer to its position in the screen RAM, so why move it to a buffer? The answer is the bottom line. As long as the entry appears elsewhere on the VDU all would be well, but D-DOS insists on printing things to the screen as it goes about its business, every time it loads the index from the disc, for example, it prints COMPLETE. If the command were on the bottom line of the screen, all the text would scroll up as a result, but the NAS-SYS pointer would ***not*** have changed and will be pointing at the wrong place, so the first thing we must do is to move the filename and any parameters entered with it safely into a buffer.

Starting Pointers

In working things out up to this point, it has become obvious that the disc index plays a central part in all of the functions we will create. And, further, that we cannot even test them when written without an index present on the disc. Somewhere in

the DOS, there will have to be a routine which formats this index on an empty disc. So although it is not a very good idea to start coding any part of the system before there is a design for each separate function, this routine is something of an exception and having decided what to store where, the code virtually writes itself in a single sequence. Like an electronic accountant, it requires little imagination but a great deal of thoroughness. In fact it makes a good example of the totally mechanical nature of disc bookkeeping. If the DOS itself lives in the first 14 sectors of TRACK 0, then the index will occupy SECTORS 15 to 18 (0F 10 12 Hex), allowing the first file to start at TRACK 1 SECTOR 1.

Plain English?

While I could proceed to fill page after page with highly unintelligible Z80 code it would not do much for those not fluent in Zilog! As a rather more useful representation here is the routine in 'logical English'.

1. PRINT a message:
   No index on disc. Shall I format? Type 'Y' or 'N'.
   PROMPT an input.
2. IF the character input is not "Y"
   PRINT a message:
   Command aborted
   and return from the routine
3. ELSE,
   SET the file index memory block to zero,
   SET file counter to zero,
   SET the empty disc track and sector pointers to one,
   and SET the empty index address pointer to zero.
4. PRINT a message:
   Single or Double sided?
   Type 'S' or 'D'.
   PROMPT an input.
   IF the character input is "S",
   enter 612 into the empty sector counter.
   ELSE IF the character is "D",
   enter 1242 into the empty sector counter.
   OTHERWISE,
   go back and perform 4 again.
5. LOAD the code "PK" into code address.
6. LOAD the RAM address of start of the index into the D-DOS workspace.
   Load the end address of the index into D-DOS workspace.
   LOAD track no.0 into the D-DOS workspace.
   LOAD sector no.15 into the D-DOS workspace.
7. CALL the "SAVE" routine in D-DOS.
8. ERASE D-DOS comments from the screen.
9. RETURN.

This routine has two functional parts. The first formats the area of memory reserved for the index, placing data where we want it, and the second records the whole block onto the disc — something we will frequently need to do, whenever we change the index after saving, erasing or renaming a file. This standard routine is at the end of the code we have written so we can call it whenever we need to, by entering the format routine at stage 6.

Taking Command

Now that we can put an index on a disc, it is time to look at our command module. And another decision awaits, what shall we use as command words? For the sake of regularity, if not vulgarity, I chose all four-letter words:

INDX SAVE LOAD WIPE NAME

which correspond, in order, to the functions described earlier.

Since, in my case, the DOS has to cope with a double drive, the command word must be followed by the letter 'A' or 'B' to specify which disc is to be accessed. This information is now enough to drive a routine like INDX, the command to print a catalogue of the disc on the screen:

INDX A

For the other functions we will have to name a file for the DOS seek out: out:

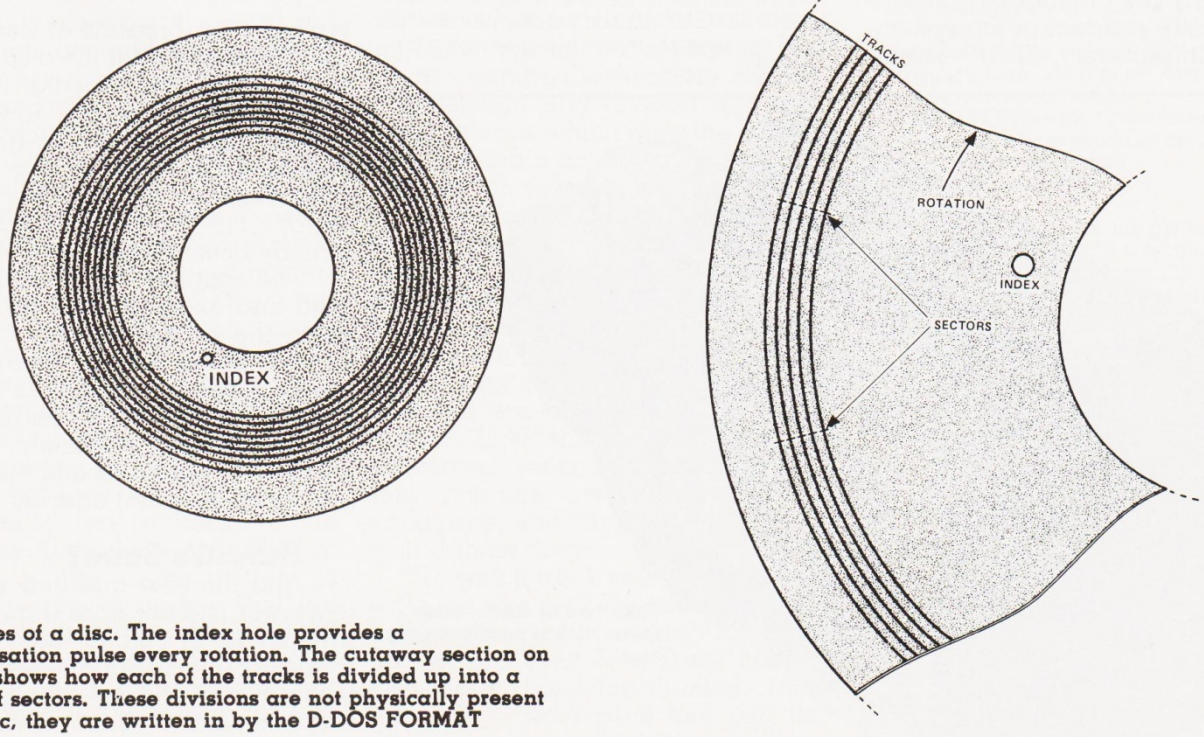
LOAD A (filename)
WIPE A (filename)
NAME A (filename)

and we can assume that the track and sector numbers of the file's address on the disc are to be found in the index, together with the address in RAM to which it should be loaded.

Function 6 is only slightly different, in that the command word is the name itself, followed by the drive letter:

(FILENAME) A

and again we shall take for granted that the address to which control is to be passed can be found in the in-



The insides of a disc. The index hole provides a synchronisation pulse every rotation. The cutaway section on the right shows how each of the tracks is divided up into a number of sectors. These divisions are not physically present on the disc, they are written in by the D-DOS FORMAT function.

dex associated with the name of the file.

That only leaves the SAVE routine's syntax to be defined and it is interesting that this, the most complex of the routines, is also the one which has to be designed first, since it is not only responsible for writing the file to the disc, but also for updating the index. Without an entry in the index to work on, none of the other functions of the DOS can operate.

Saving The Day

It is the SAVE routine which must place into the appropriate entry in the index the important parameters: name of file, load address, execute address, number of sectors occupied, starting track number and sector number.

But some of this information must be passed to the DOS with the command and so the question arises, what is the most convenient way of doing it?

My choice was this: for ordinary binary files — that is, the contents of a given section of memory — only the start and end addresses should be given as part of the command. When updating the index, the routine should prompt for an execution address. The dialogue would appear like this:

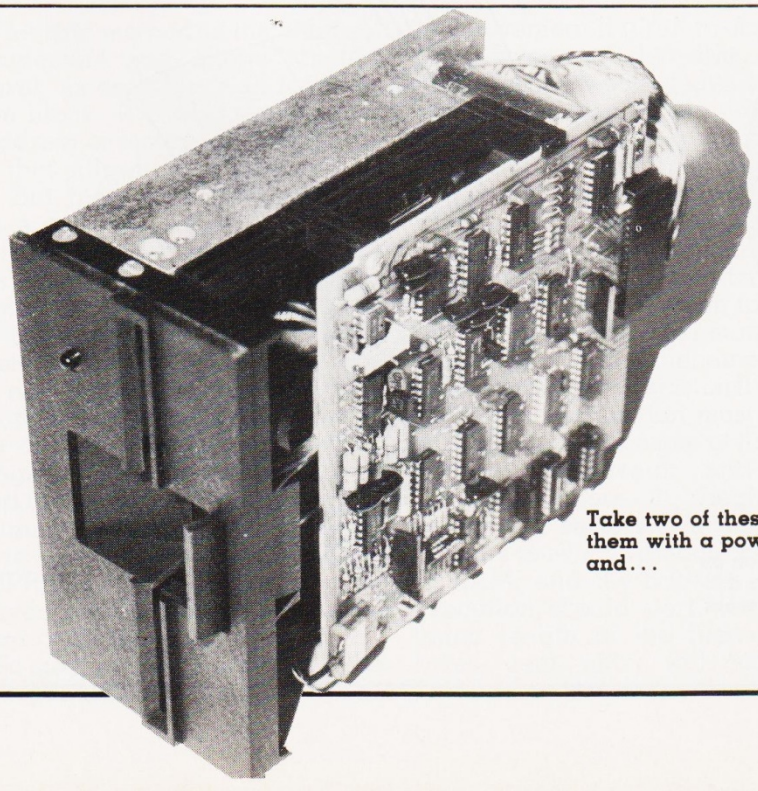
```
User:   SAVE A TEST 1000 2000
DOS:    Execute address?
        :
User:   1020
```

But for any file created by software permanently resident in the system, BASIC interpreter, ZEAP assembler, text editor etc, all these parameters are known. A NASCOM Microsoft BASIC source file, for example, must start at 1000 Hex so as to include the workspace and make it unnecessary to cold start BASIC before loading the program. Similarly, the address of the end of the program is always to be found at 10D6 Hex and the execute address could either be that of BASIC warm start, FFFD Hex, or of the RUN routine in the interpreter.

And the same sort of information is available to the DOS for ZEAP, NASPEN, and any other firmware. So we need a way of passing the SAVE routine its information about what kind of a file it is dealing with by using identifiers. I chose to use a single lower-case letter at the end of the name: 'b' for BASIC, 'z' for ZEAP, 'n' for NASPEN, 'm' for my own music compiler, and 'x' for data files where a prompt for an execution address is an unnecessary irritation.

This then is the information from the user with which the command module of the DOS has to deal. And this is how it does it:

1. STORE the stack pointer in the K-DOS workspace
2. PRINT the title on the top (unscrolled) line of the screen.
3. CALL the initialisation routine in D-DOS
4. LOAD the stack pointer with the top address of the K-DOS stack space
5. PROMPT an input with a '['
6. CALL a NAS-SYS routine to get an input line to the screen
   (* NAS-SYS uses the screen memory as a text buffer and returns a pointer to the start address of the line *)
7. INCREMENT the text pointer past the '['
8. IF the next character is a space go back to 5.
   ELSE,
   IF the next character is a CONTROL-N return control to NAS-SYS OTHERWISE
9. CALL the 'match' routine to match the first word of the command look-up table, passing the address of the first character of the command, the number of words in the table and the number of characters in the command (4).
   IF a match is not found in the table, pass control to 'load and execute'.
   ELSE,
   STORE the number returned by the 'match' routine, defining which word was found.
10. TEST the 6th letter after the start of the line.
    IF it is not a space, pass control to a "Drive Error" routine.
11. TEST the 7th letter after the start of the line.
    IF it is neither 'A' nor 'B', pass control to the "Drive Error" routine.
12. CONVERT 'A' or 'B' into 0 or 1.
    STORE the number into the drive specifier address of the D-DOS workspace.
13. FILL the filename area in the K-DOS workspace with 'space' characters.
    COPY the filename from the screen into the K-DOS workspace.
14. CALL a NAS-SYS routine to collect any four digit Hex numbers which follow.
15. LOAD the K-DOS workspace with impossible start and end-of-file pointers, to ensure an error if not later properly updated.
16. IF any four-digit numbers were entered, load them into the K-DOS start-of-file and end-of-file pointers, replacing those of step 15.
17. CALL the routine to load the index from the disc into the K-DOS index area.
18. TEST the contents of the 'code' location
    IF there is no "PK", call the index formatting routine.
19. GET back the stored number of the command found earlier.
    MULTIPLY it by four,
    ADD it to the first address of the command jump-table, and use the table to jump to the relevant routine.



Take two of these, case them with a power supply and...

We used a subroutine at stage 17 to load the index from the disc. This is easily done by copying into the D-DOS workspace: the address we wish to load the index in RAM, the number of sectors (4), the starting track number (0) and the starting sector (1); the drive number has already been passed on in stage 12.

The routines called LOAD and 'load and execute' (function 6) are much the same, the only real difference being that in these cases, the DOS doesn't already 'know' the parameters but has to search them out by finding a match for the filename in the index and then looking up the relevant address.

Harold's Bane?

And the next question we have to answer is: How does it do it? The solution is, of course, the use of a look-up table technique, the same technique as was used in stage 9 of the command module. Perhaps we could use the same routine? Indeed,



...add one of these with a D-DOS EPROM. All you need now is the information in this article or, if you're feeling lazy, write to us for a copy of the code.

as long as we make it general enough. What is required is a subroutine which, when given a pointer to the start of a word we wish to look up in the table, a pointer to the start of the table and the number of words in the table, will return the number of the word in the list if it was found, or alternatively, a way of signalling the fact that the word was not located. Because the names in the index are spaced equally apart, the routine is easier to write.

This table look-up routine is one which will frequently be used in many sections of the DOS. It has been mentioned before as a means of decoding the five command words and it is the way parameters for LOAD, NAME and WIPE are fetched from the index, because once the position of the required file in the index is known, it becomes a trivial matter to extract the other details stored with it. But the same routine is even used in the the SAVE function, because the DOS must not be allowed to store two files with the same name. It would be possible , on entering a file name which is already in use, to update that file dynamically; that is, to erase the old one and replace it with the new, giving the old one a 'Backup' identifier and erasing any previous backup file. But it is possible for files to be erased by mistake using the system, so I decided that if a file ever is to be removed from a disc in K-DOS, it must be intentional and not a by-product of some other activity.

Making Progress

The SAVE function, like the Index Formatter, is another key routine, which must be the first to be implemented, since it is responsible for maintaining the directory. In fact it is conceptually divided into two parts: the one which does the recording of the file onto the disc and the other which rewrites the index.

To save the file onto the disc, the routine must have some way to extract from the command the start and end addresses of the section of RAM it is to transfer. With a plain binary file these addresses are stated explicitly in the command line and are easily found. Where BASIC, ZEAP and NASPEN files are concerned, we know where the relevant pointers are stored in the workspace, and can direct the DOS to find them there.

To which track and sector do we write the new file? Those parameters are stored as the previous 'First Free Sector' and 'First Free Track' in the disc index. Load the numbers into the D-DOS workspace and call its SAVER routine and the file is written to the disc.

But when it comes to updating the index, bookkeeping becomes just a little more complex. What has to be done?

Add 1 to the number of files present on the disc. Subtract the number of free disc sectors in the new file from the number of free disc sectors.

D-DOS keeps a record of the next free track and sector; write then into the disc index. Add 16 to the first free index address.

Or, in English, it goes something like this:

1. CALL 'FIND' routine to see if a file by this name already exists.
   IF it returns positive, pass control to error routine
   (File name in use).
   ELSE,
2. GET the number of files present from the index.
   IF it is equal to 30 pass control to error routine
   (Disc index full).
   ELSE,
3. STEP along the filename in the buffer to the first space.
   GO back one character.
   (* the command module has placed any parameters entered with the command into the K-DOS workspace *)
   IF the character pointed at is a 'b', call the BASIC parameter loader.
   ELSE,
   IF the character is a 'z', call the ZEAP loader.
   ELSE,
   IF the character is an 'n', call the NASPEN loader.
   ELSE,
   IF the character is an 'x', call the data loader.
   (* loaders place the start and end of file parameters into the K-DOS workspace and a file-type:- 0,1,2,3, or 4 *)
   (* these parameters replace the impossible ones entered by the command module if none were included with the command itself *)
4. SUBTRACT file-start from file-end.
   IF the result is negative or zero, pass control to error routine.
   (File address error).
   ELSE,
   LOAD the result into the file-length location in the K-DOS workspace.
5. SUCCESSIVELY subtract 128 from the file length, counting the iterations, until the result is negative.
   LOAD the number of iterations into the number-of-sectors location in the workspace.
   SUBTRACT the number of sectors from the contents of the number-of-free-sectors location in the index.
   IF the result is negative, pass control to error routine
   (Disc full).
6. LOAD the start-of-file and end-of-file addresses, and the number of sectors from the workspace, and the first free track and sector numbers from the index, into the D-DOS workspace.
   CALL the D-DOS 'save' routine.
7. GET the address of the first free index record from the index.
   COPY the filename from the workspace into it.

COPY the start-of-file address into the index.
8. GET the file-type from the workspace.
IF it is 0,
PRINT a message:
"**Execute address:**"
PROMPT an input (":")
CALL a NAS-SYS routine to get a Hex number from the screen,
CALL a NAS-SYS routine to convert it to binary and
COPY it into the execution-address location in the new index entry.
ELSE,
USE the file-type to get an address from a 'BASIC', 'ZEAP', 'NASPEN', look-up table and enter it into the execution location in the index.
9. COPY the number-of-sectors from the workspace to the index entry.
COPY the first-free-track from the index as the starting track of this entry.
COPY the first-free-sector from the index as the starting sector of this entry.
10. COPY the 'next track after saving a file' from the D-DOS workspace into the 'first free track' location in the index.
COPY the 'next sector after saving a file' from the D-DOS workspace into the 'first free sector' location in the index.
GET the 'number of files' from the index, increment it, and load it back again.
11. GET 'first free index entry' address, ADD 16 and replace it.
GET the 'number of free sectors'.
SUBTRACT the 'number of sectors', and put it back.
12. CALL the routine to save the index on disc
13. RETURN control to the command module.

Now that we have a means of loading files to the disc and updating the index, we can implement the LOAD and 'Load and execute' routines we have already examined. NAME is trivial in that it only needs to find the beginning of the index entry for the file named in the command, prompt for the new name, over-write the old one with it and re-record the index.

Decisions, Decisions

For INDX itself, we have another series of choices. What do we want to display, when we examine the disc directory? For me, too much information, presented automatically, is worse than too little. When you consult INDX, it is usually to find how you spelt a filename when you saved it, or to see whether a disc holds the file you are looking for. More rarely it is consulted to find whether there is room on a disc for another file. So, the INDX routine in K-DOS presents the names of all the files on the disc, the number of files recorded and the number of sectors left empty. A separate utility can be written to display the start, end and execute address of each file, along with its disc location. Given that the names of the files are no more than nine letters long, the NASCOM screen will hold 30 filenames, three per line, with room for a line giving the two disc statistics. The filename space in the index is, conveniently, padded to length with blanks, so to put the names on the screen one has to do no more than:

1. IF there are files recorded on the disc,
2. REPEAT the following:
PRINT a name.
IF the number of filenames on this line is equal to three, print a carriage return.
UNTIL the number of names printed is equal to the number of files on the disc.
3. PRINT a message:
(**Number of files:**)
GET and print the number of files from the disc index.
PRINT a number of spaces.
GET and print the number of free sectors from the disc index.
PRINT a message:
(**sectors free.**)
4. RETURN control to the command module.

To get the names from the index, one only has to set a pointer to the start, pick up nine letters for printing and add seven to the pointer; it is then pointing to the beginning of the next name.

Curing An Itch

At this point, the DOS is beginning to fill up its allotted space on the disc. So although there are a number of very useful facilities that one might include, they must be left to a separate library. The WIPE function is the only one which is essential to have as part of the system, and at first sight it looks rather daunting. Clearly, to erase the last file is no problem. It is only necessary to clock down by 1 the record of the number of files on the disc and add the length of the erased file for the number of free sectors. But because of the simplified filing system on the disc, there is actually no way to erase a file in any other position. Removing it from the index does no good, since it simply leaves a non-addressable 'hole' in the middle. In fact, all the following files on the disc, together with their index entries, must be shuffled back to fill the gap and release vacant space at the end. It is not impossible to write the routine but it does help if you have the soul of a solicitor.

SUBTACT 1 from the file-count in the index.
FIND the entry in the index.
GET the number of sectors the file occupies.
ADD it to the count of free sectors.
IF the file is not the last one, issue a warning (**memory contents may be corrupted**).
PROVIDE an optional exit from the routine.
FIND the entry in the index
STORE the disc address.
REPEAT the following:
FIND the next index entry
MOVE it back by 10 Hex addresses,
LOAD its file to memory,
SAVE it to the stored disc address.
CALCULATE where the moved file ends,
REPLACE the stored address with the result and rewrite the index entry.
UNTIL all files are moved back.
SAVE the disc address of the end of the file last moved,
WRITE it into the first-free-sector address in the index.
ELSE,
GET the start address of the last file,
WRITE it into the first-free-sector address in the index
RECORD the index.
(**And then, just to prove that it has been done**)
DISPLAY the index.

The Final Steps

In Z80 code, the WIPE routine takes me a few bytes short of 14 disc sectors, leaving the last four of the first track for the index. Other functions kept in separate files can, because of the form of commands, be called just like system commands, so long as they are on the disc. In actually composing the code for the routines, I took a lesson from the D-DOS primitives which had formed the basis for my own program. D-DOS resides in ROM so it cannot easily be altered. But it is written so that much of it is in the form of long sequences, rather than subroutines. There are many utilities in D-DOS that I would have liked to use, but having called them, I would not have been able to escape via a RET (Return From Subroutine) before being dragged along to carry out many more instructions than I wanted. So, K-DOS is modular. Most of the actions it performs are carried out by subroutines, including the six main functions, so that it may be easily interfaced with a high-level language or data base manager. It has been in constant use for a number of months and most of the rough corners have been smoothed off by now.

And, the cat is delighted!

NASCOM owners may like to obtain a full ZEAP-style assembler listing of the K-DOS routines. If you would like one please send us an A4 SAE, ***nothing smaller will do***, and mark your letters K-DOS LISTING. Any enquiries concerning the implementation of the program on a NASCOM should be addressed to the author c/o our usual offices. Please limit your enquiries to the NASCOM range.

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Graham Knight GM8FFX

P.S. I recently had lunch with Timothy Raison M.P. at the House of Commons and along with other fellow RETRA members we are trying to get computers talking to each other via the new legal CB radio. Details in the newsletter.

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★ Original SAVE/LOAD commands unaltered
★ Reduces LOAD/SAVE times
★ Seven new SAVE/LOAD commands
★ Non-destructive memory test
★ Initialises BASIC 5 automatically if resident

BASIC 4 is a plug-in replacement for your existing BASIC 4 ROM. PRICE £11.95

INVADERS

Quite simply the best machine code game ever written for the UK101/OHIO. PREMIER have suceeded where others have failed. Our INVADERS has all the features you expect, plus superb graphics and two-player option. A firm favourite with all our customers. NOW AVAILABLE for CIE/CIU in addition to UK101. PRICE £7.95

Also now available for 32 x 48 CEGMON based UK101 BASIC 1 or 5 machines is KAMIKAZE INVADERS — a new slant on this popular game. £5.95.

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PRODUCT	KIT	BUILT
8K RAM BOARD	£29.95	£39.95
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BASICS for UK101 and OHIO

The most devastating enhancement yet, adding 17 new BASIC words to your interpreter which can be used in program lines and give machine-code response speed to graphics and formatting.

HLIN, VLIN, SCR, BLK, SET and TEST allow generation and manipulation of graphics at speeds which are unobtainable in BASIC.

PRINTUSING, PRINTAT, INAT allow total control of screen input/output.

GET (key), RD (Read DATA), GS and GT (GOSUB and GOTO a variable), GO and GO$ (GOTO a machine code routine), allow total program flexibility.

WI and CWI allow CEGMON users to manipulate their screen under variable control, using one command, in Hex or Decimal.

BASIC 5 is available for CEGMON and MON02 only, State precisely your computer and monitor when ordering. Comes complete with comprehensive manual. Available on DISK or in EPROM (9000 hex) £19.95.

SCOPYM a single disk copier

SCOPYM provides a fast, foolproof method of creating a new, useable disk from a Master. It will copy the first fourteen tracks of a disk in around 1.25 minutes. All copying is automatic; SCOPYM provides a safe, simple and extremely fast and efficient way of creating a new disk. It is supplied complete with comprehensive notes. For 5.25" OS65D users only. £9.95.

SOUND/V.I.A. BOARD

The TES II VIA/SOUND kit gives you up to 56 Input/Output lines and programmable sound generation. In order to allow you total flexibility in designing your system, we are offering the kit in low-cost packs.

The Base Kit consists of PCB, connector, address decoding and buffering, plus IC sockets.

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COMPACT

This useful machine code program provides UK101/OHIO users with a utility that they have been waiting for — a BASIC line compactor.

COMPACT looks at the resident BASIC program and adds lines together wherever possible, thus aiding running speed and saving memory space. It is an extremely reliable way of compacting your program. COMPACT lives at the top end of your memory and willrun with any monitor — please state memory size when ordering. Price £7.95.

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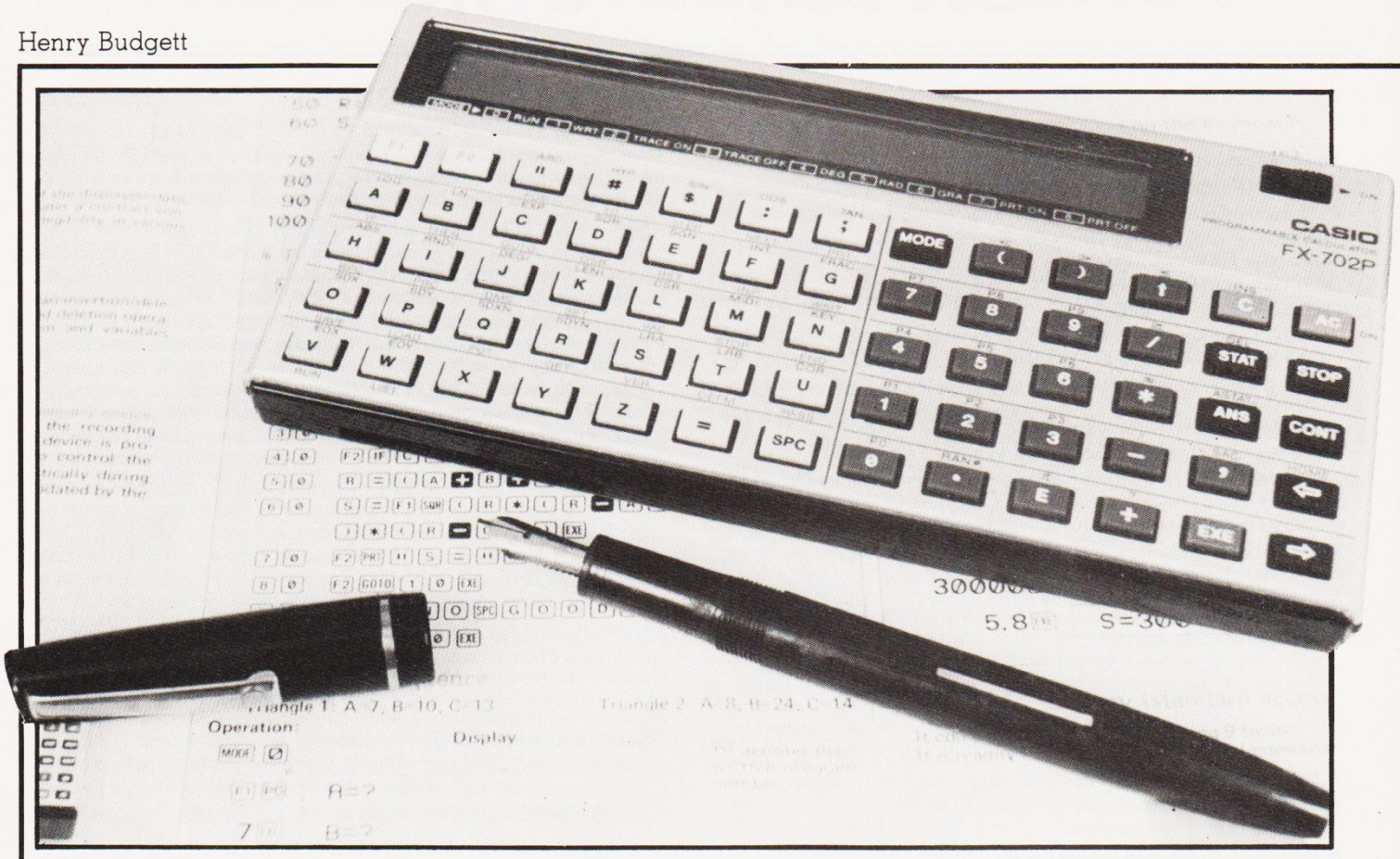


A brief look at Casio's answer to the Sharp PC1211, their newly launched FX702 pocket computer

At last Casio have taken the logical step in their programmable calculator range and launched the FX-702P. Described as a BASIC Pocket Computer it must be regarded as a direct rival to the already established Sharp PC 1211.

Although the two are in direct competition to one another they do have some fairly significant differences, both in physical appearance and in their methods of operation. I shall not spend too much time in direct comparison with the Sharp as we reviewed this in depth in our August '80 issue but I will present a brief summary at the end of the report.

The Physical Machine

Casio's offering is some 165 by 81 by 18 mm and sports 65 keys, more of which later, and a 20-character alphanumeric LCD display. The contrast of this display is adjustable for varying light conditions by means of a small edgewise control at the rear and is clear and distinct. The display also carries a four-digit counter at the extreme right which gives the number of program steps remaining in memory. Further information is displayed across the top of the window as to the current mode of operation, system status, etc.

The keyboard is, in my opinion at least, one of the machine's major shortcomings. Divided into an alphabetic section on the left (the white keys), and a numeric and function section on the right (the coloured keys), it is not QWERTY in layout and takes quite a lot of getting used to. (That statement represents the opinion of someone who is used to the QWERTY layout and I suspect that anyone who is moving from ordinary calculators to this system without being influenced by 'normal' keyboards would have less trouble.)

At the top left of the alpha section are two keys labelled F1 and F2 which act as a two-level shift to gain access to some 80 functions. Of this 80 there are no less than 56 dedicated to single key programming, an indication of the thought that has gone into the design.

At the left-hand end is a covered seven-pin socket where the FA-2 cassette and printer adaptor will locate. (The cover could do with being a little better made as it periodically drops off.) Underneath the right-hand end is a sliding plate which gives access to the battery compartment and the odd-looking edge connector where, it is rumoured, the extra memory modules will fit.

One highly unusual thing about all the samples that have passed through my hands in recent weeks is their extraordinary curved shape.

The Soft Option

The major, and fundamental, difference between the two machines is their approach to the BASIC language. Sharp broke completely away from their calculator background with the PC 1211 and gave it a limited but very usable BASIC. Casio have taken the alternative approach and effectively extended the range of commands of the FX-602. This difference could well cause a split in the market with those acquainted with the Casio range buying the 702 as a logical extension and those who are into BASIC buying the PC 1211.

The 702 has many more commands in its repertoire than one would expect from such a dainty little device. In fact one begins to wonder whether one actually needs

all the extra trig and statistical operations built in: perhaps they would have been better offered as a plug-in module à la TI?

I am not going to list all the functions but it is nice to see that they have included a string processing command — even if it is exceedingly primitive it does do the job.

Manuals, Extras And Add-Ons

Both the Casio and the Sharp come with a manual and a Program Library and they both suffer from the Japanese English syndrome. The information, one feels, is all in there somewhere but sometimes it's more than a little obscured.

The Program Libraries are both quite good and give a wide range of software, the Casio book has slightly less in it than the alternative offering.

At the time of writing Casio did not yet have their printer or cassette interface available but both are promised for the end of the year. Whether they will be clip-on units like the Sharp's or connected via cable is not yet certain but they will undoubtedly offer the same kind of facilities.

Concluding The Evidence

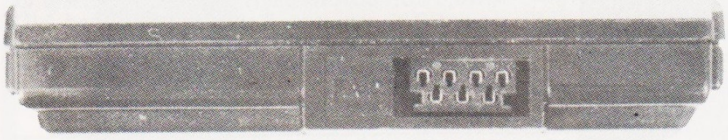
I think it is fair to say that the Casio has been designed as a logical extension to their impressive range of programmable calculators rather than as a dedicated BASIC Pocket Computer. The manuals, the separate program memories, the abbreviated command words and other points all indicate this. However, this does not detract from the fact that it is a very good product. It has remarkable repertoire of commands built in and, apart from the awkwardness of its keyboard, has a lot to offer against its rival.

To make the decision between the two one must really try them both. My preference is for the Sharp but that's probably a case of 'what you're used to' and I'm sure that, given time, I'll get just as familiar with the 702.

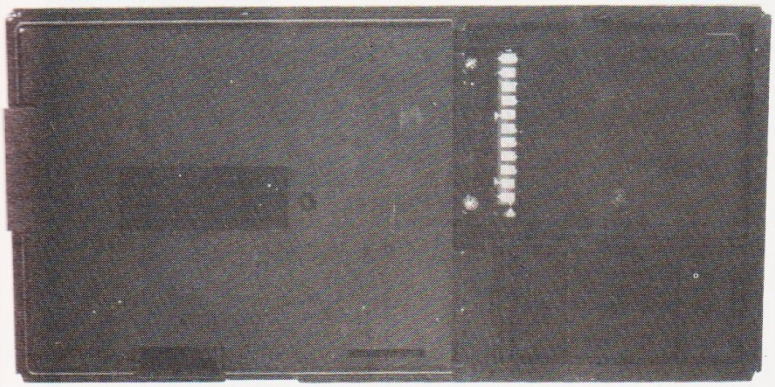
For those interested in the technical aspects, I've included a table of the fundamental points of each of the machines.



This is the FX-702's big rival, the already well established Sharp PC1211. The cradle in which it sits is the combined cassette and printer interface. As you can see, the connection between them is made by plug/ socket connector at the right, compare this with the Casio version below.



This is the socket where Casio's FA2 printer/ cassette adaptor will fit. The similarity between the two indicates that the adaptor may well slip onto the end of the machine in the same way as the Sharp unit.



Above: The edge connector underneath the FX-702. Strong indications that more memory will fit in here but whether it'll be ROM or RAM I'm not sure.

My thanks to both Casio and Tempus for lending machines for this review.

Right: A quick comparison chart of the two machines shows their overall similarities. The difference may well lie in the user markets.

	FX-702P	PC 1211
CPU	CMOS	4-bit CMOS
Program Space	1680 steps	1424 steps
No of memories	22-226	26
Built-in programs	10 max	18 max
Display	20 character	24 character
Type	LCD	LCD
Keyboard	Alphabetic	QWERTY
Program storage	Cassette	Cassette
Adaptor	FA-2	CE-121
Printer	FP-10	CE-122
Power	2 3V cells	4 1.35V cells
Numbers	10 + 2	10 + 2
String handling	Yes	No
Statistics	Yes	No
Price	£117 approx	£92 approx

TTLs

74 SERIES

7400	11p
7401	11p
7402	12p
7403	14p
7404	14p
7405	18p
7406	27p
7407	27p
7408	16p
7409	15p
7410	15p
7411	20p
7412	20p
7413	25p
7414	35p
7416	25p
7417	25p
7420	17p
7421	30p
7422	22p
7423	28p
7426	30p
7427	25p
7428	30p
7430	15p
7432	25p
7433	27p
7437	28p
7438	13p
7440	17p
7441	70p
7442A	50p
7445	60p
7446A	93p
7447A	45p
7450	17p
7451	17p
7453	17p
7454	17p
7460	17p
7470	36p
7472	30p
7473	30p
7474	23p
7476	30p
7480	50p
7483A	45p
7485	90p
7486	25p
7489	210p
7490A	30p
7491	60p
7492A	30p
7493A	30p
7494	50p
7495A	50p
7496	45p
7497	120p
74100	85p
74107	130p
74109	140p
74116	90p
74118	75p
74119	90p
74120	70p
74121	30p
74122	45p
74123	48p
74125	40p
74128	40p
74132	45p
74136	32p
74141	65p
74142	200p
74145	70p
74147	100p
74148	75p
74150	80p
74151A	45p
74153	45p
74154	70p
74155	50p
74156	50p
74159	100p
74160	66p
74161	60p
74162	60p
74163	60p
74164	65p
74165	60p
74166	70p
74170	160p
74173	75p
74174	70p
74175	70p
74176	50p
74177	70p
74178	100p
74180	160p
74182A	160p
74182A	90p
74184A	90p
74185	120p
74186	500p
74188	325p
74190	70p
74191	70p
74192	70p
74193	70p
74194	70p
74195	60p
74196	60p
74197	60p
74198	100p
74199	100p
74221	75p
74259	150p
74278	150p
74279	80p
74283	75p
74284	200p
74285	200p
74290	200p
74293	100p
74298	100p
74365	50p
74366	55p
74367	55p
74368	55p
74390	100p
74393	100p
74490	120p

74LS SERIES

74LS00	12p
74LS01	14p
74LS02	14p
74LS03	14p
74LS04	15p
74LS05	15p
74LS08	16p
74LS09	15p
74LS10	15p
74LS11	15p
74LS12	15p
74LS13	25p
74LS14	45p
74LS15	30p
74LS20	15p
74LS21	15p
74LS22	16p
74LS26	18p
74LS27	18p
74LS28	18p
74LS30	15p
74LS32	16p
74LS33	16p
74LS37	16p
74LS38	16p
74LS42	40p
74LS47	40p
74LS51	15p
74LS55	30p
74LS73	75p
74LS74	20p
74LS75	28p
74LS76	20p
74LS83	45p
74LS85	80p
74LS86	24p
74LS90	35p
74LS92	40p
74LS93	35p
74LS95	90p
74LS96	110p
74LS107	45p
74LS109	30p
74LS112	34p
74LS113	30p
74LS114	30p
74LS122	42p
74LS123	50p
74LS124	120p
74LS125	30p
74LS126	30p
74LS132	45p
74LS133	30p
74LS136	30p
74LS138	36p
74LS139	36p
74LS145	75p
74LS147	60p
74LS148	90p
74LS151	30p
74LS153	60p
74LS154	200p
74LS155	40p
74LS156	40p
74LS157	35p
74LS158	36p
74LS160	40p
74LS161	40p
74LS162	40p
74LS163	40p
74LS164	48p
74LS165	00p
74LS166	90p
74LS170	90p
74LS173	70p
74LS174	60p
74LS175	50p
74LS181	140p
74LS190	50p
74LS191	50p
74LS192	50p
74LS193	60p
74LS194	40p
74LS195	50p
74LS196	60p
74LS197	65p
74LS221	60p
74LS240	90p
74LS241	90p
74LS242	80p
74LS243	80p
74LS244	90p
74LS245	90p
74LS251	40p
74LS253	40p
74LS257	45p
74LS258	45p
74LS259	90p
74LS260	24p
74LS266	25p
74LS273	90p
74LS279	45p
74LS280	250p
74LS283	45p
74LS298	160p
74LS299	450p
74LS323	250p
74LS324	180p
74LS348	150p
74LS365	36p
74LS367	36p
74LS368	50p
74LS373	80p
74LS374	80p
74LS375	50p
74LS377	90p
74LS378	70p
74LS390	55p
74LS393	60p
74LS399	200p
74LS445	110p
74LS540	135p
74LS541	135p
74LS640	200p
74LS641	200p
74LS642	200p
74LS643	200p
74LS644	250p
74LS645	250p
74LS668	200p
74LS669	200p
74LS670	170p

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74S02	60p
74S04	60p
74S05	75p
74S08	75p
74S10	60p
74S11	60p
74S20	60p
74S30	60p
74S32	90p
74S37	90p
74S74	90p
74S85	300p
74S86	180p
74S112	90p
74S113	90p
74S114	90p
74S124	300p
74S132	160p
74S133	75p
74S138	225p
74S139	225p
74S157	250p
745163	300p
74S174	250p
74S175	320p
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74S262	£10
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74C01	20p
74C08	28p
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74C20	28p
74C42	95p
74C48	143p
74C73	57p
74C74	59p
74C76	57p
74C85	134p
74C90	99p
74C95	106p
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74C151	255p
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8224	250p
8226	250p
8228	250p
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3.276MHz	250p
3.5795MHz	175p
4.00MHz	290p
4.194MHz	250p
4.43MHz	125p
6.0MHz	250p
6.144MHz	250p
7.0MHz	250p
7.168MHz	250p
8.00MHz	250p
8.86MHz	250p
10.00MHz	250p
10.7MHz	250p
15.0MHz	350p
16.00MHz	250p
18.00MHz	250p
18.423MHz	250p
19.968MHz	390p
26.690MHz	300p
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ULN2004A	100p
75017	160p
75110	160p
75112	160p
75114	160p
75115	160p
75150P	140p
75154	140p
75182	230p
75324	375p
75361	150p
75363	150p
75365	150p
75451/2	72p
75453/4	72p
75491/2	70p
8126	120p
8128	140p
8195	140p
8197	140p
81LS95	90p
81LS96	120p
81LS97	90p
81LS98	120p
9602	220p
9637AP	160p
ZN425E-8	350p
ZN426E-8	350p
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14 pin **35p**	20 pin **60p**	28 pin **80p**
16 pin **40p**	22 pin **65p**	40 pin **100p**

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8 pin **9p**	18 pin **16p**	24 pin **24p**
14 pin **10p**	20 pin **18p**	28 pin **26p**
16 pin **11p**	22 pin **22p**	40 pin **30p**

CONNECTOR SYSTEMS

EDGE CONNECTORS

	0.1"	.156"
2x18 Way	—	150p
2x22 Way	310p	170p
2x23 Way	335p	—
2x25 Way	350p	200p
1x43 Way	260p	—
2x43 Way	450p	—
1x77 Way	700p	—

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	PLUG	SOCKET
DIN41617 31Way	160p	160p
DIN41612 2x32Way	300p	400p

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HEADER	RECYCLE	EDGE
PLUG		
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26 Way 350p	265p	390p
34 Way 450p	325p	450p
40 Way 525p	370p	
50 Way 575p	450p	

HEADERS WITH COVERS

14 Way	130p	24 Way	280p
16 Way	150p	40 Way	350p

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10 Way	65p	26 Way	160p
14 Way	90p	34 Way	240p
16 Way	p	40 Way	280p
20 Way	140p	50 Way	330p

ADD SOUND TO YOUR ZX80/81 PLUS RELAY CONTROL AND LIGHT DETECTION

★ZX80/81 USER PORT★

(as described in "P.C.W." Oct. '81)

Port module plugs directly into ZX80or 81 to provide 8 input and 8 output lines. These allow input of data from switches, photocells, joy-sticks etc., and control of up to 8 relays. Also 7-segment displays or LED lamps may be used and solid state buzzers may be directly connected to the port. Variable tone audio output may be produced. The port is accessed by simple PEEK and POKE commands. The port kit includes plugs, sockets, double-sided PCB and all components. Prices: Kit **£11.50**
Ready Built & Tested **£15.00.**
Application Notes **£1.00** + S.A.E. (Reprint from PCW Oct/Nov '81).

UK101/OHIO II TWO BOARD HARDWARE INTERFACE

DECODING BOARD plugs into UK 101/OHIO II socket to provide 16 bit user port plus a wide variety of decoded lines for interfaces (inc. full decoding for AY3-8910/12 PSG) and a 40-pin socket for further expansion. Kit **£27.50**
ANALOGUE BOARD plugs into decoding board to provide D/A converter, 8-channel multiplexed A/D converter AY3-8910 PSG plus 6522 timer IC allowing complex timing and counting functions, plus 16-bit port. Kit **£39.95.**
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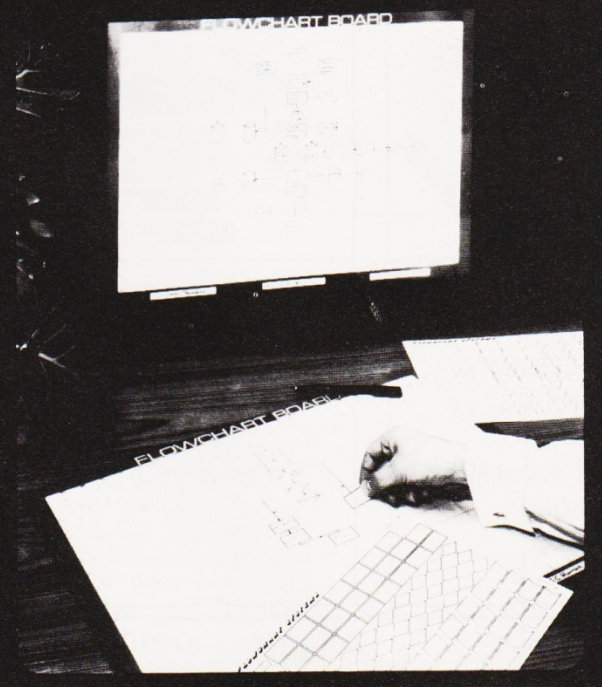

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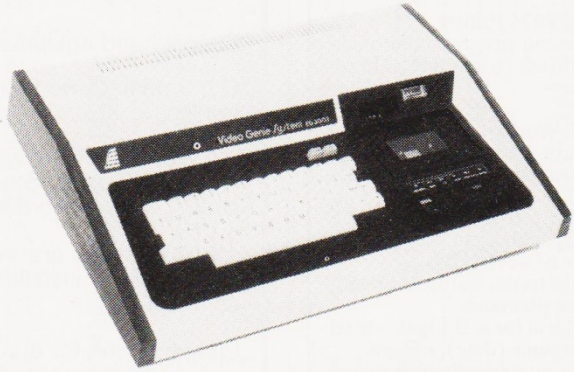

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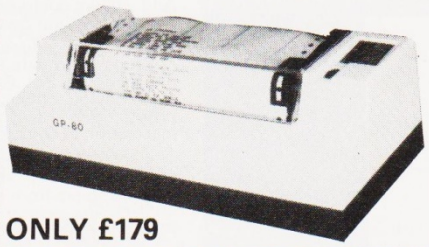

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PROGRAMMING LANGUAGES

Dr G J Marshall

We turn our attention to ALGOL and its favourite son, Pascal, in this month's exploration into the world of the high level language

ALGOL was devised during the late 1950s and early 1960s. Its formal design culminated in a document published in 1963 and entitled 'Revised Report on the Algorithmic Language ALGOL 60'. Thus, ALGOL 60 was contemporary with FORTRAN, and the two were the first high-level languages of consequence. ALGOL is classified as a language for scientific computation: it can be used for other applications, but a lack of data structures can cause difficulties. In particular, facilities for handling strings and characters are rather limited in much the same way as they are in FORTRAN IV.

An Historical Interlude

As the first high-level languages, ALGOL 60 and FORTRAN were in direct competition. ALGOL was logically designed and formally defined in a report, whereas by contrast FORTRAN was developed on a relatively ad hoc basis. However, the outcome in terms of practical usage was overwhelming in favour of FORTRAN, particularly in America. ALGOL found favour in academic circles, even in America, particularly for the teaching of introductory programming courses, because it encouraged secure programming methods more than FORTRAN did. One of the objectives of ALGOL was to provide a language in which computational procedures, or algorithms, could be expressed with precision. Despite the almost overwhelming use of FORTRAN, when the American Association for Computing Machinery (ACM) began to publish a section on algorithms in its journal Communications, it adopted ALGOL as the language in which they should be expressed.

Although ALGOL 60 is still widely used and implementations are widely available, with one in the CP/M library, for example, its current importance is, in fair measure, historical. It has given rise to many important languages including Pascal and 'C', which assume major importance as languages for microcomputers. Figure 1 shows the lines of development of some of the languages descended from and influenced by ALGOL 60. The 'tree' showing the developments has branches showing the lines of development of general purpose languages, real-time languages and systems programming languages.

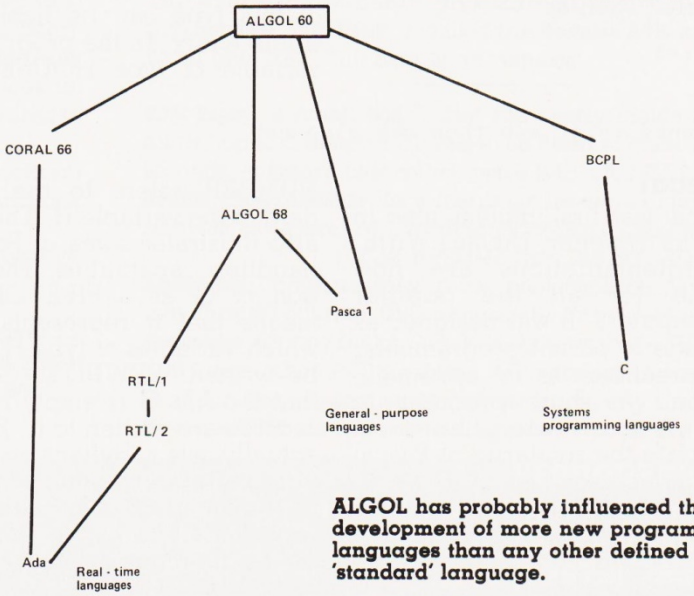
ALGOL 68 is a separate language from ALGOL 60, conceived as a langauge in its own right and defined in its own formal report. Much admired in academic circles, it is a general purpose language which has proved difficult to implement fully. In particular, implementations are scarcely sufficiently compact for current microcomputers. Pascal was influenced by both ALGOLs. The line of development through various real-time languages leads towards Ada, while BCPL and 'C' are systems programming languages.

The aspects of ALGOL which gave it such influence on subsequent languages include the overall clarity and unity of its structure as a language, its block structure and its control features, the way in which the language is defined, and its support of recursion. With ALGOL, systematic methods of program development could be encouraged and well-structured programs could be produced. When ALGOL 68 was designed, it was developed from a small set of orthogonal (that is, separate and independent) concepts. It was also intended to be extensible, so that new operators or data structures could be defined as required and then used as part of the language. The successor languages spawned by the ALGOLs have adapted and refined their features in various ways. Thus, Pascal contains in a natural and flexible form all the control structures needed for structured programming, as well as very general data structures. Another legacy is seen in 'C', which is a small, compact language containing features with which it can be extended in any direction required by the programmer.

ALGOL 60

The following provides an example of a short, simple ALGOL 60 program:

```
begin  real a, sumsquare, rms;
       integer i, n;
       sumsquare :=0; n :=0;
       for  i :=1  step 1 until 20 do
       begin  a :=read;
              sumsquare :=sumsquare+a x a;
              if a=0 then n :=n+1
       end ;
       rms :=sqrt(sumsquare);
       write text("r.m.s. value is"); print(rms, 3, 3);
       write text("number of zero entries is");
       print(n, 2, 0)
end
```



ALGOL has probably influenced the development of more new programming languages than any other defined 'standard' language.

This program illustrates a number of characteristic features of ALGOL. Firstly, an ALGOL program consists of a block which starts with BEGIN and is terminated by END. All the variables to be used in the block must be declared at the start, and the declarations are followed by the program statements which use the declared variables. The program listed here consists of a single block, but programs can have complex block structures, and can contain inner blocks with their own locally declared variables. The so-called delimiters of ALGOL — begin, if, for, etc — are underlined here to distinguish them from, for example, variables with identical names. In other versions of written ALGOL programs they may be distinguished in different ways, such as by writing them within inverted commas.

The compound assignment symbol (:=) serves as a reminder that an assignment is required by the instructions that use it, and it also distinguishes assignment from the equals sign of an equality relation. The facilities for repetition include step ... until and while. Input and output were the only feature of ALGOL 60 not to be formally defined, and as a consequence input and output instructions vary from one implementation to another. The input and output instructions in the program listed here are from the ICL implementation of ALGOL 60.

The sub-program in ALGOL is the procedure, and ALGOL supports recursion, that is to say, procedures are permitted to call themselves. This is in contrast to FORTRAN and BASIC, in which subroutines may not call themselves. ALGOL also permits instructions of considerably more sophistication than, say, FORTRAN and BASIC, such as

```
a :=b :=5
```

and

```
difference := if a<b then b-a else a-b
```

Pascal

Pascal was first implemented in 1970 by its designer, Niklaus Wirth, and implementations are now available for all the popular microcomputers. It was designed as a language to permit programming to be practised as a systematic discipline. A short program in Pascal is presented here to demonstrate the similarity of Pascal to its predecessor, ALGOL 60. It also illustrates a few of the features possessed by Pascal which did not exist in ALGOL.

The program that follows creates a file of records. Each record contains several items of information about a house. These detail are entered, and the program, handling a record as a single item, creates a file of as many of them as may be required. The program is:

```
    PROGRAM HOUSEFILE (G);
    TYPE HOUSE=RECORD
                NUMBER :INTEGER
                NAME :PACKED ARRAY[1:20] OF CHAR;
                LENGTH, WIDTH :REAL
                END;
VAR H :HOUSE;
    G :FILE OF HOUSE;
BEGIN
    REWRITE (G);
    WRITELN ('ENTER NUMBER');
    READ (H.NUMBER);
    WHILE H.NUMBER <> 0 DO
      BEGIN
        WRITELN ('ENTER NAME');
        GETLN;
        READ (H.NAME);
        WRITELN ('ENTER LENGTH')
        READ (H.LENGTH);
        WRITELN ('ENTER WIDTH');
        READ (H.WIDTH);
        G^ :=H;
        PUT (G);
        WRITELN ('ENTER NUMBER');
        READ (NUMBER)
      END;
    RESET (G);
END.
```

This program is intended to illustrate that the form of a Pascal program and the appearance of Pascal instructions are both similar to those of ALGOL. It also shows that one of the improvements of Pascal over ALGOL is in its data structuring capabilities. The record of type HOUSE is defined as consisting of an integer, a string of 20 characters and two reals. However, a variable of this type can be handled as a single entity. In the program, H is a variable of type HOUSE, and H. NUMBER refers to the NUMBER field of the variable H. The program also illustrates some of Pascal's file handling capabilities. The declaration of G as a FILE OF HOUSE means that it represents a file to which variables of type HOUSE can be written. REWRITE (G) ensures that the file G is empty before any records are written to it. RESET (G) actually sets a 'buffer variable' (that is, a variable maintained by Pascal for communication between a Pascal program and a file) to the first item in the file, but in some systems it also ensures that the file is properly closed. In a file, G, the buffer variable holding the currently available item of the file is denoted by G . Thus, the instruction G := H sets the buffer variable to the just-entered variable, H, and PUT (G) then puts it in the file.

Conclusions And Further Reading

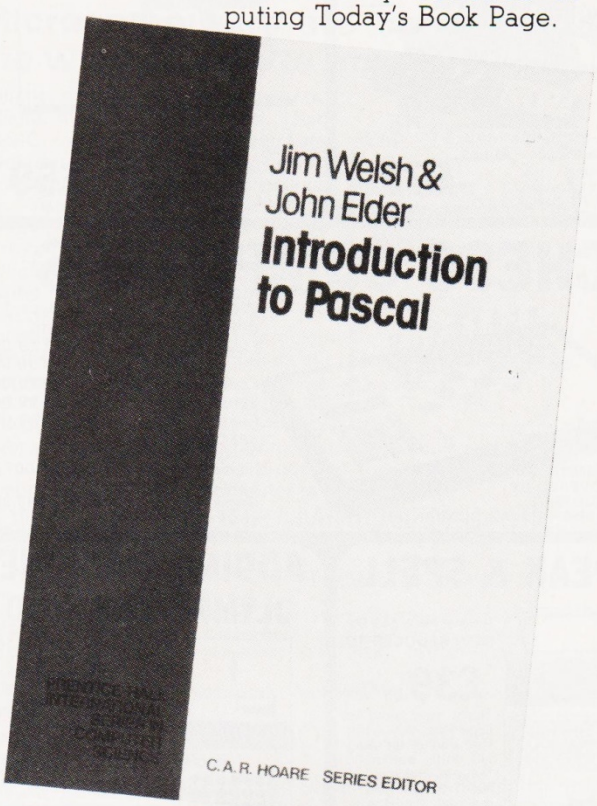
Implementations of ALGOL 60 are available for the Research Machines 380Z and in the CP/M library. However, for anyone about to learn a programming language, ALGOL would hardly be a sensible choice given that Pascal is a superior language and that it is readily available for all the popular micros.

Of the many introductory texts on ALGOL, I am biassed towards **First course in ALGOL 60** by E Foxley and H Neave (Addison-Wesley), mainly because one of the authors was my tutor when I was an undergraduate, while the other was a fellow student. It hardly needs repeating that the required reading on Pascal is **Pascal user manual and report** by K Jenson and N Wirth (Springer-Verlag, 1975). Good introductions to Pascal are also provided by **A practical introduction to Pascal** by I Wilson and M Addyman (MacMillan, 1978) and **Pascal for programmers** by S Eisenbach and C Sadler (Springer-Verlag, 1981). The latter, inciden-

PROGRAMMING LANGUAGES

tally, is based on a series of articles in another computing magazine and was recently reviewed in Computing Today's Book Page.





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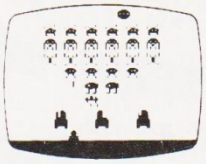

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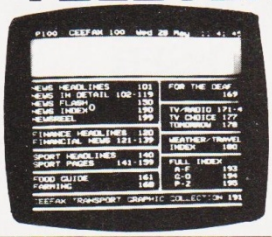

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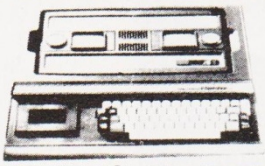

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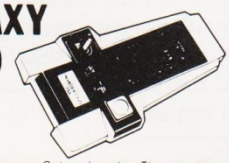

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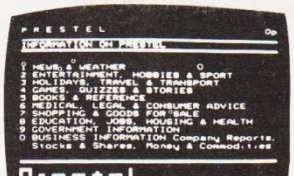

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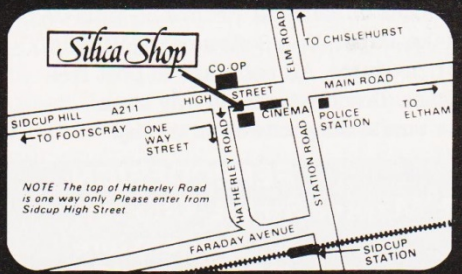

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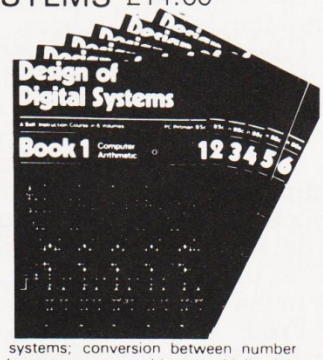

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S M Gee

A selection of volumes that may, or may not, be suitable for filling the gaps in your library

With Christmas in mind, I cast around this month for books that might make good presents and came up with some that you might like to give and others that you might like to be given.

The Making of the Micro is the nearest to a coffee-table computing book I've ever come across. It's splendidly produced and will appeal equally to people who know a lot about computers and those who are new to the subject. I imagine it could even awaken an interest in the most stubborn of your luddite acquaintances. This is a hardback with a smart dust-jacket, attractively illustrated throughout with photographs and drawings. A feature I liked is the inclusion of plotted biographies of all the characters introduced together, in almost every case, with a portrait of them.

This book tells the story of computing in a readable and a very human way. This is because it is about the evolution of the calculating machine, ie machines that handle numbers, and the people who invented and developed them. Famous names, such as Napier, Pascal and Babbage are brought to life but we also learn about less well known characters from William Oughtred (1575-1600), a clergyman who is credited with inventing the slide rule, to the men, such as Dr John Pinkerton, who are still involved in contemporary developments in England. Not that the history is confined to England: Germany and the USA also figure prominently.

Christopher Evans's account is always lively and at times it is dramatic. I found the book compulsive reading and could not put it down until I'd finished it. For example, his chapter 'The Spur Of War' recounts how in the 1930s there were independent efforts being made in Germany, the USA and England, to design a universal computer. Evans makes you consider how differently the war might have turned out if Zuse's machines had been developed as tools of war in Germany and the development of the Colossus code-breaking computer, with Alan Turing, had not been fostered in England.

Tragically Chris Evans died in 1979 before he had finished this book. The last chapter of the book, which traces the development of the technology culminating in the silicon chip, was written by Tom Stonier.

It is, of course, possible to enjoy all the benefits of the microprocessor without having the faintest idea of its history. However, this book presents the history in so fascinating a way that I thoroughly recommend its study as a subject in its own right.

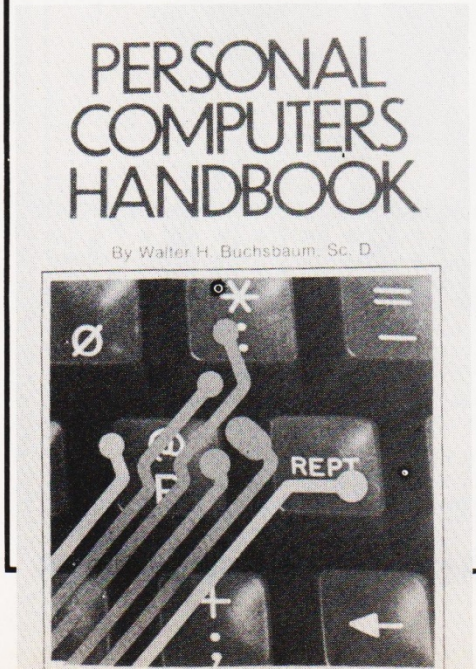
The next book might also make a suitable gift for anyone who maintains a resolute determination against all the odds, to ignore the place of the computer in the world of modern business. **Fred Learns About Computers** takes a very different approach to most introductory texts and if you've never come across the Fred books this one's worth hunting down just to broaden your horizons. I'm going to leave such readers unenlightened — suffice it to say that Fred comes from Fredland, a kingdom with its own currency and its own constitution, the major outstanding feature of which is that it is 'uniquely typical'.

Fred starts from the premise that 'a computer is as stupid as a donkey' and is surprised when his friend and mentor, Rufus, actually agrees with him that computers are stupid. Under Rufus's careful guidance, however, Fred comes to see the usefulness and relevance of the computer to his company's business. In this book, Fred learns about how the computer accepts information as a pattern of electrical pulses, how information can be stored, how to input information, and about programming (in BASIC and COBOL), machine code, assemblers and operating systems. This book is geared to large mainframe systems, and its second half is mainly devoted to large-scale data processing, and discusses topics such as timesharing and real time systems. In the final chapter, however, other applications of the microprocessor, from computerised cash registers using light pens through word processors to teletext systems, are briefly introduced.

Fred books are intended to promote relatively painless learning. They employ a conversational style and cartoons, sorry — 'pictorial analogies'. I tended to find the former just a little annoying but the latter were in general helpful and certainly made reading what I would otherwise have found a slow paced explanation (admittedly about a subject with which I am by no means unfamiliar) a pleasure rather than a chore.

What about those of you who are still saving up for your micro? There are many books designed to assist your choice and I've been looking at three recent ones. I'll quickly skate over the **Guidebook to Small Computers**, an American book which is devoted to a description of a variety of systems only half of which are popular in the UK. Because the microcomputer market moves so fast that this selection already seems dated, despite the fact that it only appeared in 1980.

The Personal Computers Handbook comes from the same publishers, Sams, but is a much more comprehensive book. It includes just one chapter of examples of the machines available together with a discussion of what to look for to meet your requirements. The books is aimed at readers who 'have a working knowledge of electronics' and throughout the book the subject of computing is tackled from the point of view of the innards of the machine. I found this book very readable and I imagine even those of you without an electronics background could learn a good deal about the workings of microcomputers from the chapters on 'How A Computer Computes', 'Microprocessors', 'How Information Can Be Stored' and 'Memory For Your Computer'. Two chapters are devoted to input and output functions and to at-



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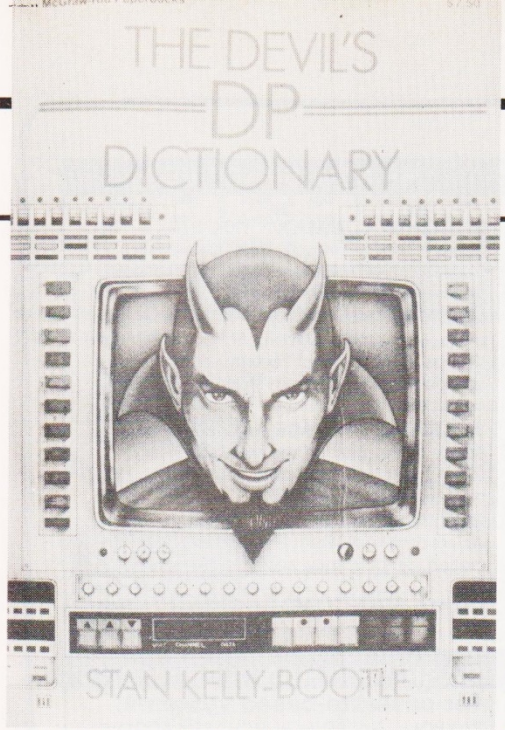

taching peripherals to your machine and another two discuss programming with examples in a very clear way. If you are an electronics buff you'll find the chapter on 'Troubleshooting Hardware And Software' useful but the short section on debugging software does not get beyond the obvious. Worth a special mention is the chapter on applications which does present a good range of ideas in enough detail to allow the reader to take them up and to think of more. All in all I found this a very useful book and would recommend it both to those of you already in electronics who want to launch into computers and to those of you who already know how to use a micro but now want to understand how it works.

The Good Computing Book for Beginners is written from the opposite viewpoint. Dennis Jarrett believes that the best way to consider a computer is as a functional object which does something and that 'you don't necessarily need to know anything about how or why it works, or how it was made'. He does, however, devote 13 pages to chapter two, 'What Goes On Inside' which is billed as 'a swift canter through the heavy technology, avoiding irrelevant and/or difficult ideas'. It starts 'this may be a bit technical', which is unnecessarily alarmist, and advises that readers who experience 'technofear' to go straight to chapter four on 'What's A Personal Computer', 14 pages covering popular models, applications, what to buy and where to buy it.

The 'Practical Introduction' part of the book occupies just 50 pages which means that neither the chapter on programs nor that on what to look out for when buying your system can be more than a superficial glimpse at the subject.

The bulk of the book is 'A Practical Glossary'. It is comprehensive but flippant and simplistic to the point where it ceases to be informative. For example, for 'flip-flop':

> 'Woolies used to do good ones, and if you can afford them surf shops tend to have great flip-flops. The rest of us will have to make do with something along the lines of a bi-stable electrical component — which could be a toggle switch, or it could be a logic gate. Forget it.'

More worrying, when it comes to definitions of electronics terms, there are some howlers. For example, take LCD (Liquid Crystal Display) which (apparently) in general do not 'light up' unless you set fire to them with a flame thrower! Similarly, LED (Light Emitting Diode) which (also apparently) is not 'a simple electron tube which lights up when you pass electricity through it' — valves are usually absent from personal computers!

Another attempt at a lighthearted glossary succeeds to the point where it had me in stitches. **The Devil's D P Dictionary** will appeal to anyone interested in computing but the more you know the more you will laugh. Indeed, some of the jokes can be used to test just how deeply 'in' your acquaintances are since they will only laugh if they have very specialised knowledge. Take, for example:

ISAM file: (Acronym for Intrinsically Slow Method or rare Indexed Sequential Access Method.) One of the most successful data-security systems so far devised. Information is protected from all but the most persistent, patient and devious.

Not all the jokes are absolutely new — some are elaborations of old chestnuts — but you can open this book at any page and start giggling immediately. Let me give you a few examples:

Microprocessor: Twenty years of architectural bungling concentrated into a single chip.

Module: (Hardware) any portion of a system that can fall off during shipment; any element in a system which can be replaced but not mended.

My program: A gem of algoristic precision, offering the most sublime balance between compact, efficient coding on the one hand, and fully commented legibility for posterity on the other.
compared with:
Your program: A maze of non sequiturs littered with clever-clever tricks and irrelevant comments.

There are two main types of entry in the dictionary, definitions, as in the above examples, and 'diatribes' which are in miniscule type to be 'beyond the reach of legal beagality', a wise precaution since they are often decidedly irreverent. Here I'll restrict myself to a witty but safe example:

Bus: A ponderous vehicle for people or data at irregular intervals. Note however that 'missing the bus' has opposite connotations in the people and data environments: a failure for folk, but a blessing for bits. Of the contending mini- and microbus formats, the ruthless, teutonic SS-100 standard is certain to dominate. As the name suggests, a task force of highly motivated 'standards specialists' regularly descends upon nonconforming stockists, outside of normal trading hours, and throws some rather exegetical pitches. Few can resist the board crunching logic of these visits.

The diatribes sometimes break into verse or even song — so it helps if you recognise the parodies.

I find it virtually impossible to choose my favourite definition from this book but if I was asked to select just one it would be:

Debugger (Anglo-Irish): The person who sold us our system.

This is a book I am going to keep under lock and key — in case anybody else gets hooked on it too and walks off with it!

The books included in this month's selection were:

The Making of the Micro by Christopher Evans, published by Victor Gollancz Ltd (1981), 115 pages, £5.95.

Fred Learns About Computers (second edition), published by Macdonald and Evans (1981), 159 pages, £2.95.

Guidebook to Small Computers by William Barden, distributed by Prentice Hall, published by Sams (1980), 127 pages, £3.20.

Personal Computers Handbook by Walter Bhuchsbaum, distributed by Prentice Hall, published by Sams (1980), 286 pages, £7.75.

The Good Computing Book for Beginners by Dennis Jarrett, published by ECC Publications (1980), 296 pages, £1.95.

The Devil's D P Dictionary by Stan Kelly-Bootle, published by McGraw-Hill (1981), 160 pages, £3.95.

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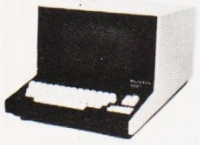

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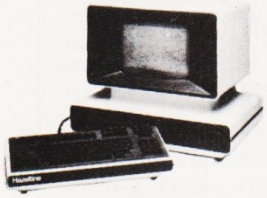

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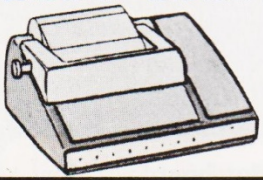

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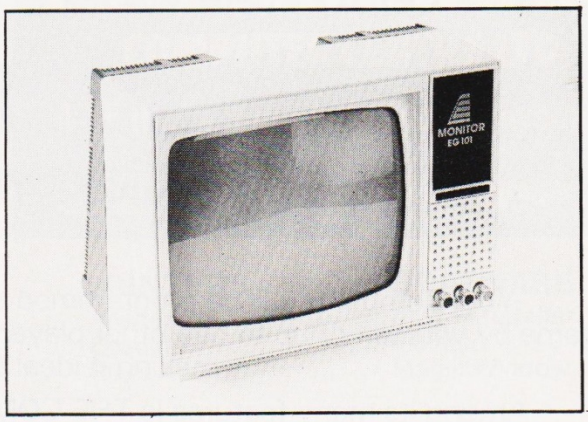

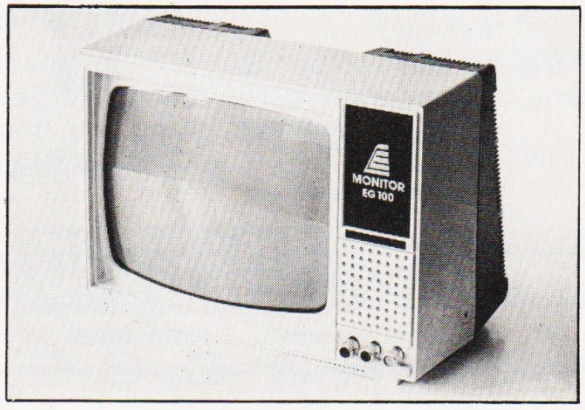

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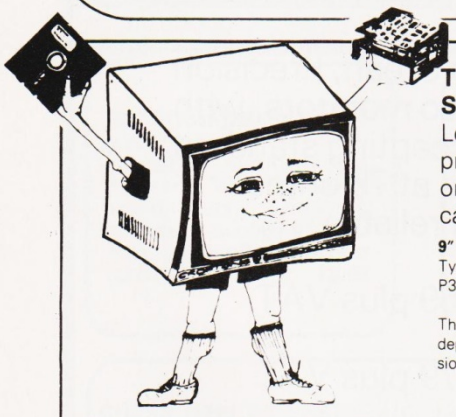

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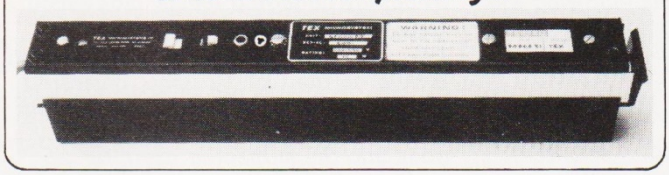

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Dear Sir,
I am sure most of your readers will have heard about the BBC television series on computers, **The Computer Programme**, which starts next January. There is already tremendous interest in the BBC Microcomputer itself and we believe that the series will do a great deal to stimulate further interest in all aspects of computers and computing. Many viewers will want to follow up the series by discovering what is available in their area in the way of courses, computer clubs or centres offering hands on experience. One way of finding out this information will be through the Computer Referral Service run by Broadcasting Support Services, as part of the Computer Literacy Project.

Our address will be given at the end of each programme and anyone wanting further information can write in. To be able to answer all the enquiries we need to hear about what is going on locally. Some of the information we already have, but what we are particularly keen to learn more about are computer clubs. Clubs will have a major role to play as they can be an ideal source of informal advice and hands on experience for people who don't want to go on a formal course or who aren't quite sure what they want to do yet.

Ideally, what we would like to be able to say to people is 'here is your nearest computer club, this is when they meet, why not go along and talk to them and see if this is what you want'. To do this though we need to know which clubs are willing to help out in this way. If any clubs are interested could they write to us at the Computer Referral Service, PO Box 7, London W3 6XJ.

Yours sincerely,
Leslie Morphy
Director.

Dear Sir,
I intend to set up a computer club in my town and write in the hope that you can publicise this information. The first meeting was held in late October and, at the time of writing, we already had five machines to demonstrate and the necessary premises.

Anyone interested in joining can contact me at 19 Carrickburn Road, Carrickfergus, Co Antrim BT38 7ND or ring me on Carrickfergus 63788 after 5.30 pm.

Thanking you in anticipation,
David Bolton.

Dear Sir,
I was interested to see Professor George's comments on my article in the September '81 issue of CT. He makes a number of specific points — perhaps I can comment on each in turn.

Match Sequence
The article stated explicitly that my examples were for teams following the 'normal' home-away-home-away pattern of matches. This gives the home team in the first case a record of HW,AD, and the away team one of AW,AD.

'Last week' is, indeed, a less than precise reference to 'last match'.

Concentrating on Draws
Because of the space restrictions imposed by a 16K computer, my data base can only predict the 'probability' of draws occurring in each match; I agree with Professor George that all matches have **some** chance of being draws. I would have liked also to assess the 'probability' of home and away wins, since I believe that being able to identify the relative likelihood of each possible result would improve the system's ability to identify the 'most likely' draws. There should be a close correlation between draws predicted by this, more complete, approach and those predicted by my program's simpler methods. I infer from Professor George's comments that the more detailed analysis might, in fact, be wasted; if that is the case, then thank you for the hint.

Inclusion of Scottish Second Division
The Professor has carried out a much more complete analysis than I have, and I must bow to his comments that draws are just as likely in the Scottish Second as anywhere else. I will repeat, however, that they do not seem to occur under the same circumstances as in other divisions. It would not be difficult to extend the program to include these matches.

My aim, though, was to produce the simplest reasonable program that could cope with the maximum number of cases. To my mind, such a program should be as quick and straightforward to use as possible. Satisfying this requirement means that all activities of little value, such as maintaining a Scottish Second data base, should be eliminated. This philosophy means accepting a slight reduction some weeks in the number of matches from which draws are selected — on average, there are 1.5 Scottish Second matches on the coupon — but it does produce a simple, and therefore likely to be used, program.

In principle, the program and its data base could be used to predict non-league results, but I cannot recommend its use in that way. The data base comes from the results of the professional league matches — I have no evidence, one way or another, to suggest that non-league matches would yield draws under the same form conditions as the English and Scottish leagues. My feeling, however, is that there would be a significant difference, since the pressures on the non-league teams are very different, and they will therefore respond differently; perhaps Professor George can comment? In the same vein, we may well find that this season's experiment of awarding 3 points for a win will affect the usual trends by changing teams' motivation.

Unexpected Draws
I hope that my comments in the second article, in the Oct '81 issue, answered the point about the need for a random element. The **New Scientist** article goes into the subject in great detail.

Overall, I am happy to take note of Professor George's comments, coming as they do from a leading authority in the black art of forecasting. He recognized, correctly, that space forced me to leave some aspects out of my articles and, in addition, he raises a number of intriguing points that I had dismissed, or not considered. He has given me several interesting lines for investigation.

Yours faithfully,
D S Peckett.

Dear Sir,
I would like to take issue with a number of the points raised by Ron Keeley in his recent review of the Triumph Adler ALPHATRONIC microcomputer. I cannot avoid having the feeling that the main complaint was that the machine was a little different to the majority of systems on the market.

The first point he raises is that of the disc drives not being spring mounted. What he is overlooking is that in most systems the discs are not accessible without such mounting. The BASF drives used in the ALPHATRONIC were designed in such a way that the discs are always accessible. This has the benefit of helping to minimise the number of mechanical functions which may go wrong. To an inexperienced user who has no previously established habit patterns to shake off (in fact the very person whom Mr Keeley was attempting to emulate, and also to whom the system is aimed), this should prove to be no handicap at all.

Another point which is found to be "disconcerting" is in fact one of the more powerful features of the machine. This is the various shift modes, toggled by the SM key, which are available to the user. These modes allow the machine to be used in computer mode; ie upper case and numerics, shifting to obtain lower case and special characters, and typewriter mode; ie lower case and numerics, shifting to obtain upper case and special characters. This latter mode is especially useful when the ALPHATRONIC is being used in conjunction with word processing software. I must point out that, contrary to the article, this SM key is not programmable, as should be self-evident from its function.

As far as software packages not restarting goes, this is simply a matter of how the various software houses have gone about protecting their work from illicit copying. On some packages for instance, it is not possible to interrupt the run, save the program to

another disc, and then restart in any way at all. This I must emphasise is purely a matter of how the software house has designed the system.

An extremely important point which was raised is the matter of video I/O. The article states that the screen is not memory mapped and is, therefore, not user accessible. Nothing could be further from the truth. The screen is memory mapped and is very easy to access, as a study of the memory layout chart on page 39 of the article illustrates. Information on how to use this feature can be obtained either from the system handbook or via a telephone call to TA who are always willing to assist. In fact, information on any feature of the machine is generally available for the asking, including machine code routines to handle cursor control.

Mr Keeley complains of the lack of information on the programmable function keys. I can only suggest that he refers to either the operating instructions which come with every machine or the systems handbook with which he was provided, both of which document the codes generated by these particular keys. It must however be remembered that BASIC will strip the parity bit from any character entered, although this is not mentioned in the manual.

If Mr Keeley would like to get in contact with us about his problems with the CLEAR instruction, we will be more than happy to help him out.

From the detail Mr Keeley enters into in his article, I find it extremely difficult to understand how he has reviewed the system from the point of view of "a first time non-technical user". If he had, I am sure that he, like hundreds of our users, would find the ALPHATRONIC an extremely reliable, versatile and easy to use machine for the first time user.

Finally, may I thank this magazine for the opportunity of replying to Mr Keeley's review and correcting several non-factual comments.

Yours faithfully,
J M Letherbarrow
MARKETING MANAGER
Triumph Adler (UK) Ltd
27 Goswell Road
London EC1M 7AJ

(Exercising considerable personal restraint (the Editor has hidden my axe) I shall concentrate on the three 'facts' which emerge from the above...
1. I stated that the SM key is apparently programmable because the keyboard comes up in one shift-mode under BASIC and in the other when running a word processor, all without the intervention of the operator.
2. A memory-mapped display is one in which an area of RAM is shared both by the CPU and the screen refresh circuitry. The Alphatronic's display is part of a flexible I/O system in which data is organised into 'streams' that can be switched between various logical/physical devices. This is not the same thing. However, it is possible for BASIC to interpret PEEK or POKE commands in terms of the routines necessary to manipulate screen information in such a way as to simulate a memory-mapped display. Such a system will appear to an operator to be no different. Since I was unable to PEEK or POKE randomly to the screen, it follows that the version of BASIC current at the time of my review did not support these functions. The new version, it seems, does so.
3. I am happy to accept Adler's assurances that the function keys (and, presumably, the cursor controls) are programmable. I cannot comment, at this time, on the presence/absence of the parity bit except to recall that, in working through the character set by a series of PRINT CHR$ (x) statements, no cursor movements resulted although it did respond to the CHR$ (13) designation for Clear Screen.)

Dear Sir,
I wonder whether you might include the details given below in your 'Printout' feature to let your readers, resident in or visiting Scotland, know about our organisation which was formed earlier this year.

The details are as follows:

Scottish TRS-80 Users' Group, Edinburgh. Meetings on the second Thursday of each month, at 7.30 pm, normally in the Mansion House Hotel, West Milton Road. Software Library and monthly Newsletter. Contact Dick Mackie on 031-229 6032, or at 3 Warrender Park Crescent, Edinburgh EH9 1DX.

Many thanks,
Yours faithfully,
Dick Mackie,
Honorary Secretary.

Dear Sir,
As Secretary of the North West TRS-80 Users Group I feel that the public and prospective microcomputer purchasers should be informed of a recent problem that one of our members has experienced, with Tandy, in relation to their after-sales service.

It was pointed out to our member, by their Burnley store manager, that because his CPU was six months old it was no longer within Tandy's warranty, and that Tandy do not give more than 90 days warranty on their computers.

Firstly I should like to bring to the attention of prospective purchasers, that TRS-80's purchased from sources other than Tandy, of which there are numerous, they can get a full 12 months warranty.

Secondly that the apparent attitude of Tandy, on after-sales service, seems to have gone full circle. As in the past I personally have had very good after-sales service, but with Tandy's recent attitude this seems to have disappeared.

I am, on behalf of our group and the member mentioned above, taking steps to find out whether Tandy have the legal right, under the Sale of Goods Act, to actually reduce a purchasers' right to a 90 day period.

It is my opinion that this letter should also be circulated to all other TRS-80 User Groups and perhaps the national press. At least if the fact that Tandy's 90 day warranty stands in a court of law, prospective purchasers of a TRS-80 will know and can decide for themselves where to make their purchase.

Melvyn D F Franklin
(Group Secretary).

Dear Sir,

I am writing to inform you that as from the end of September I shall cease to be responsible for the running of the Atom User Group. The group will be taken over by Peter Frost at the address below. I would be very grateful if you would note this change and publicise it at your earliest convenience.

I would also like to take the opportunity to thank all those who have helped me while I have been running the User Group.

Yours sincerely,
Richard Meredith
c/o 18 Frankwell Drive
Potters Green
Coventry CV2 2FB

Dear Sir,
I find Phil Reeve's article on Uncrashing Compukit most useful. However, there is a mistake in his instructions by which others may be confused. The second type of error remedy he suggests is to delete the offending line, and retype it. This method will only work if the number resulting from the corruption is higher than the legitimate line number preceding it. For instance, if one has a program numbered from 10 to 1000 in steps of 10, and line 440 becomes corrupted, if this number is say 233, then when one tries to delete line 233, the input of lines routines in BASIC will search through the list, and when it reaches line 240, will assume there is no line 233. Thus it is impossible to delete this line. Another problem that can arise, is if the corrupted line number duplicates an earlier valid one, in which case the valid line will always be deleted.

The only cure for these problems is to enter machine code, and correct them from outside BASIC, the same way they were messed up in the first place. I hope this saves a few people some bother.

Yours faithfully,
N E G Berry
Aldershot.



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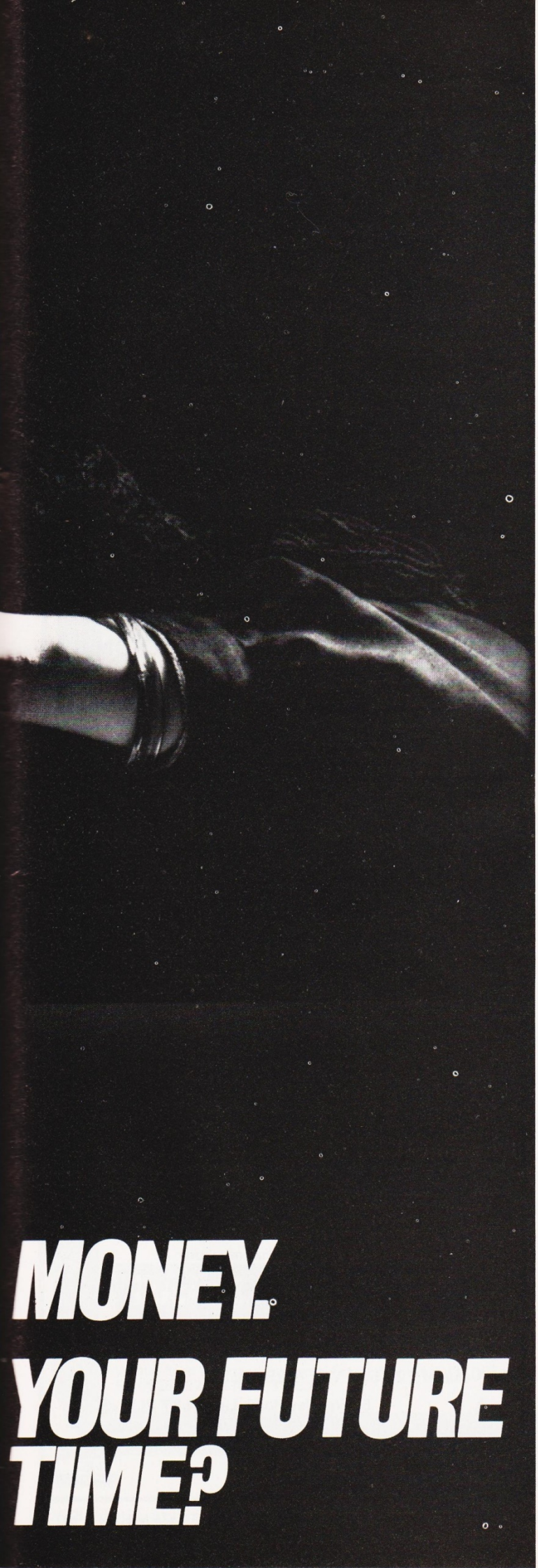

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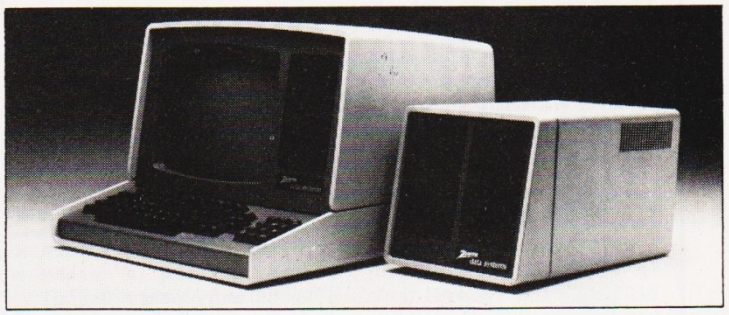

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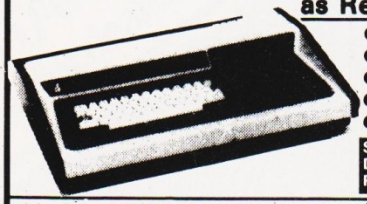

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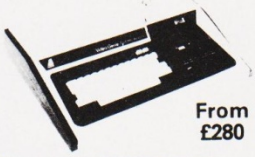

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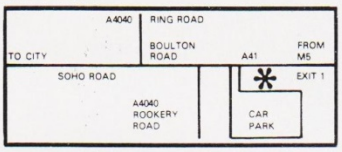

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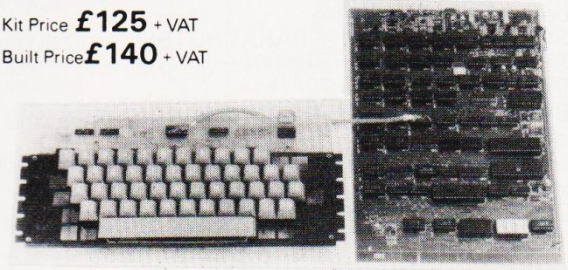

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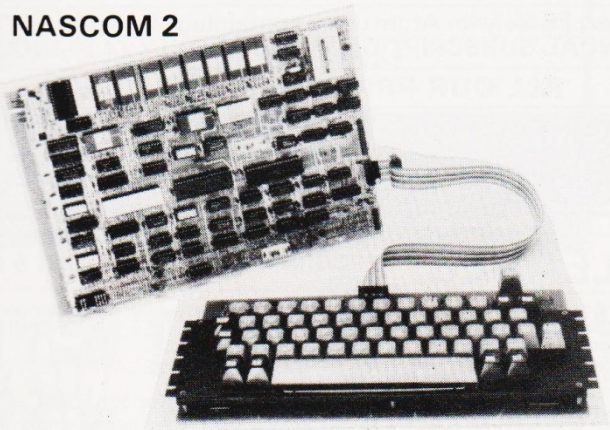

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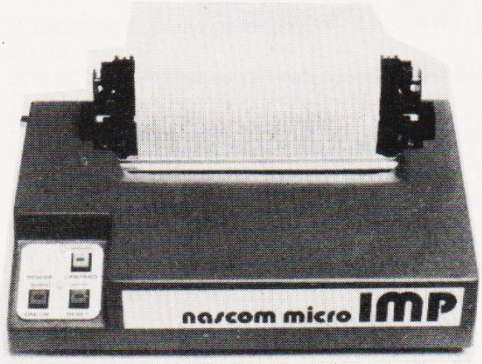

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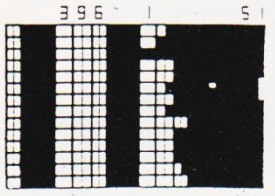


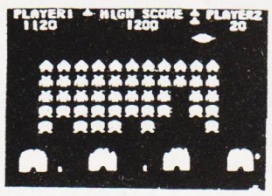

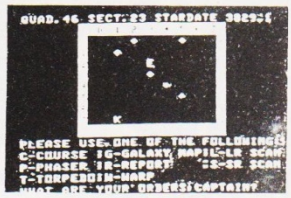

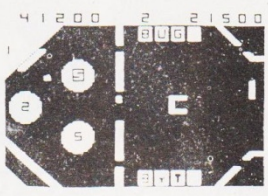

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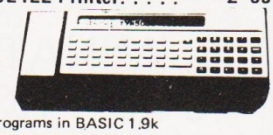

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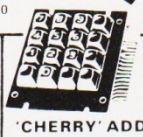

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BACKNUMBERS

Backnumbers issue list

July 1980
Battle of Britain simulation, Multiple choice exam program, Address list program, Kingdoms game.

August 1980
Multipurpose records program, Conlan language, Floppy discs examined, Systematic programming theory.

September 1980
Pascal overview, PC 1211 reviewed, BASIC dialects, Othello and Ski Run programs.

November 1980
A special graphics issue containing; Graphic Details, Interactive Graphics, Results Plotter, Space Invasion game.

March 1981
SuperPET review, 6502 programming course, Boolean algebra on micros, Golf simulation.

July 1981
Holocaust wargame, Data entry validation routines, Multiple column records program, Media survey.

August 1981
Rubik's Cube simulation, DAI colour computer reviewed, Micro Assembler in BASIC, Micro sound effects unit.

September 1981
Football pools prediction Pt.1, Connecting a printer to your micro, VIC reviewed, Upgrading PETs to 32K, Gladiator simulation program.

October 1981
How to choose your first system, Pools prediction program, Compressing text, Upgrading BASIC, ATOM programming.

Last month's issue is still available as well but has not yet reached the end of its 'shelflife' and is not included for this reason.

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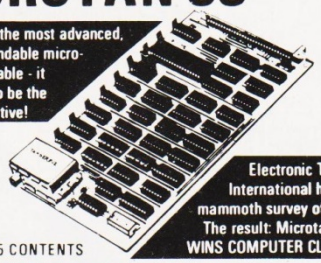

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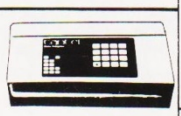

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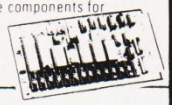

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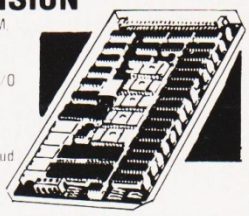
TANEX EXPANSION



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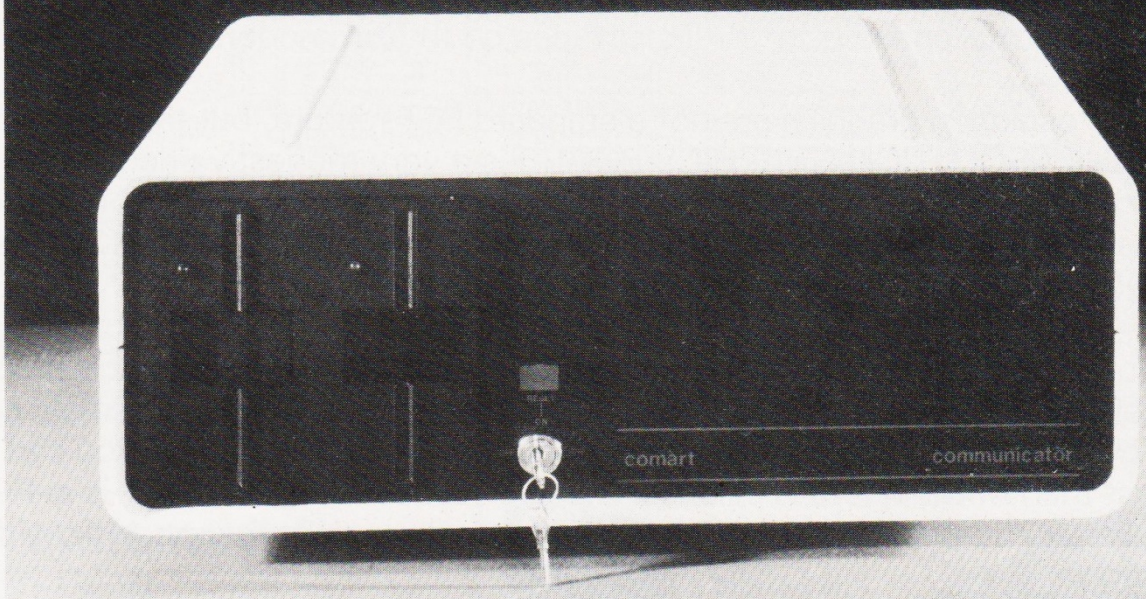

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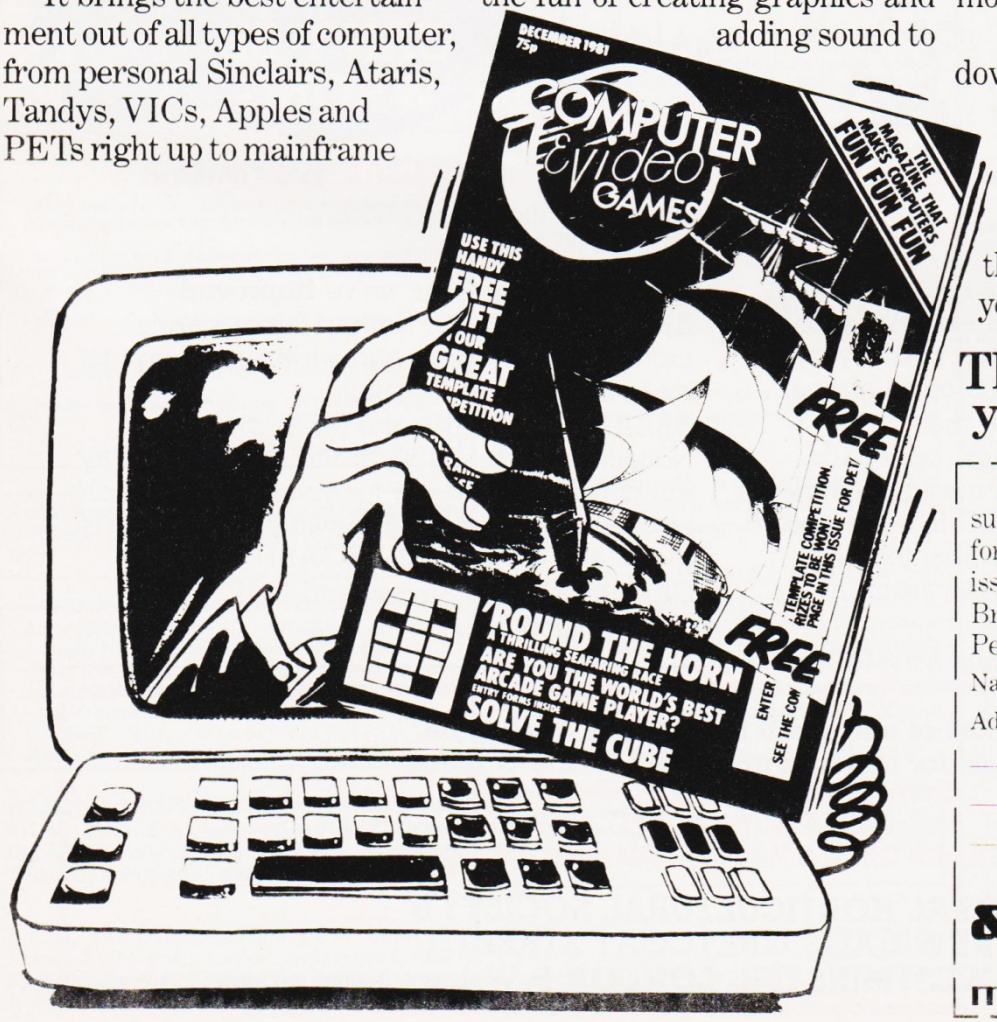

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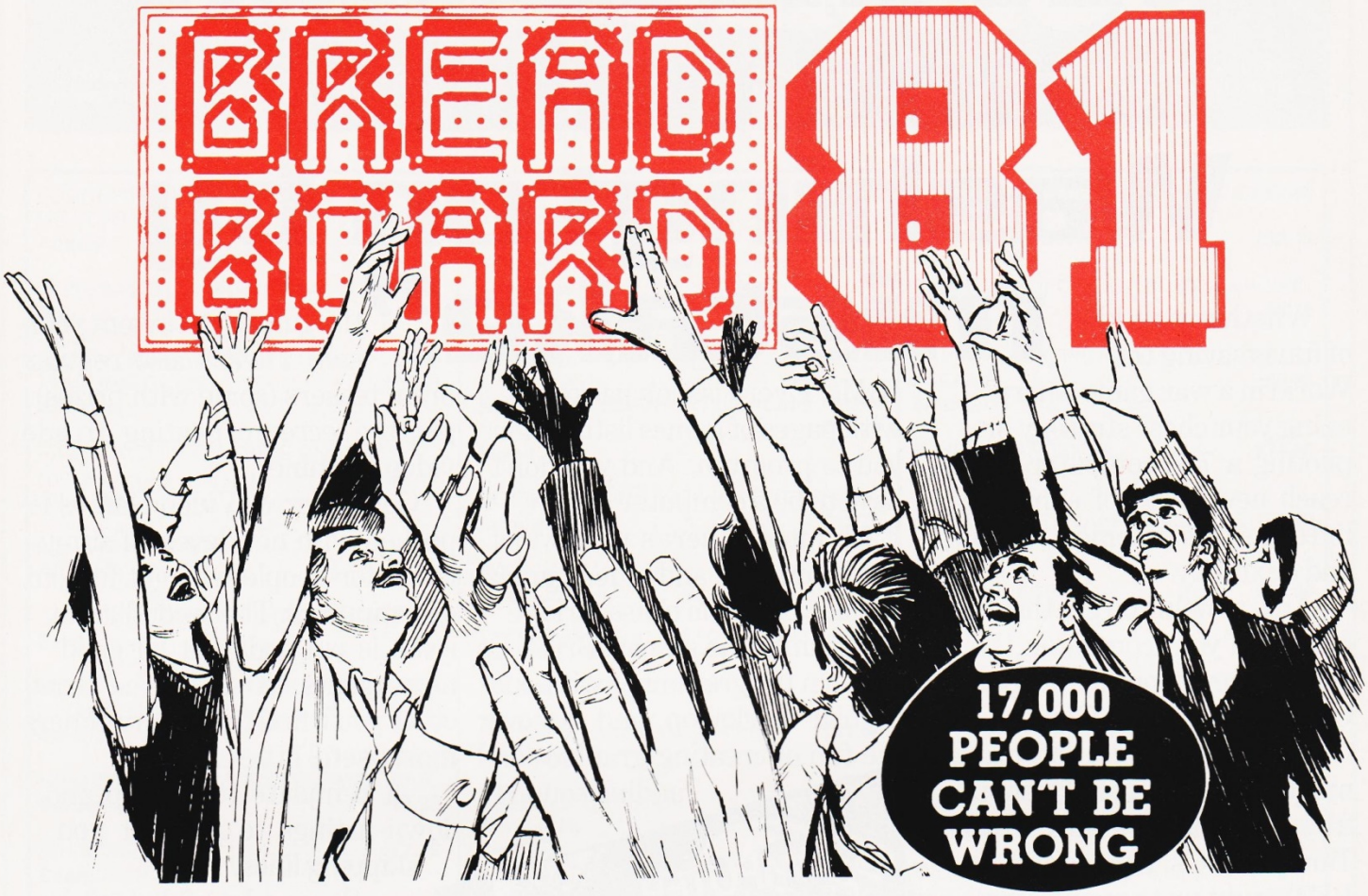

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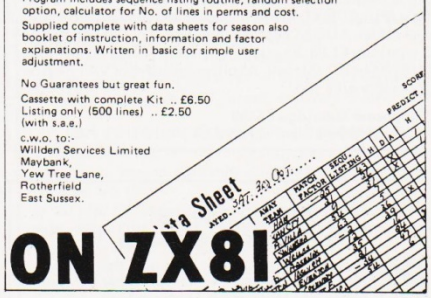

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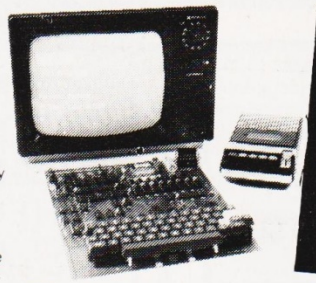

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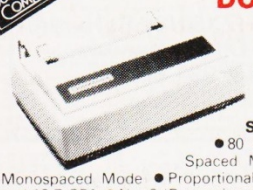

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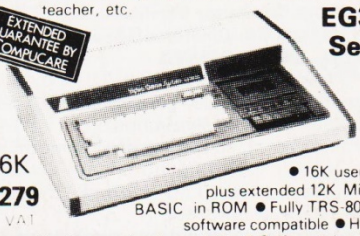

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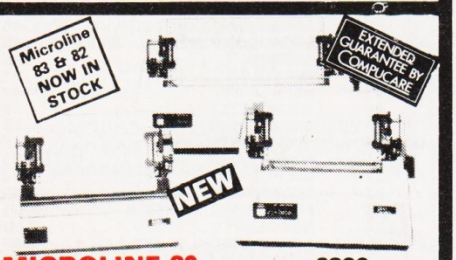

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ingenious!

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

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

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

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





New!...Expander

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

New!...Printer

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





Disk Drive

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

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