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computing today

NOVEMBER 1981

ISSN 0142-7210

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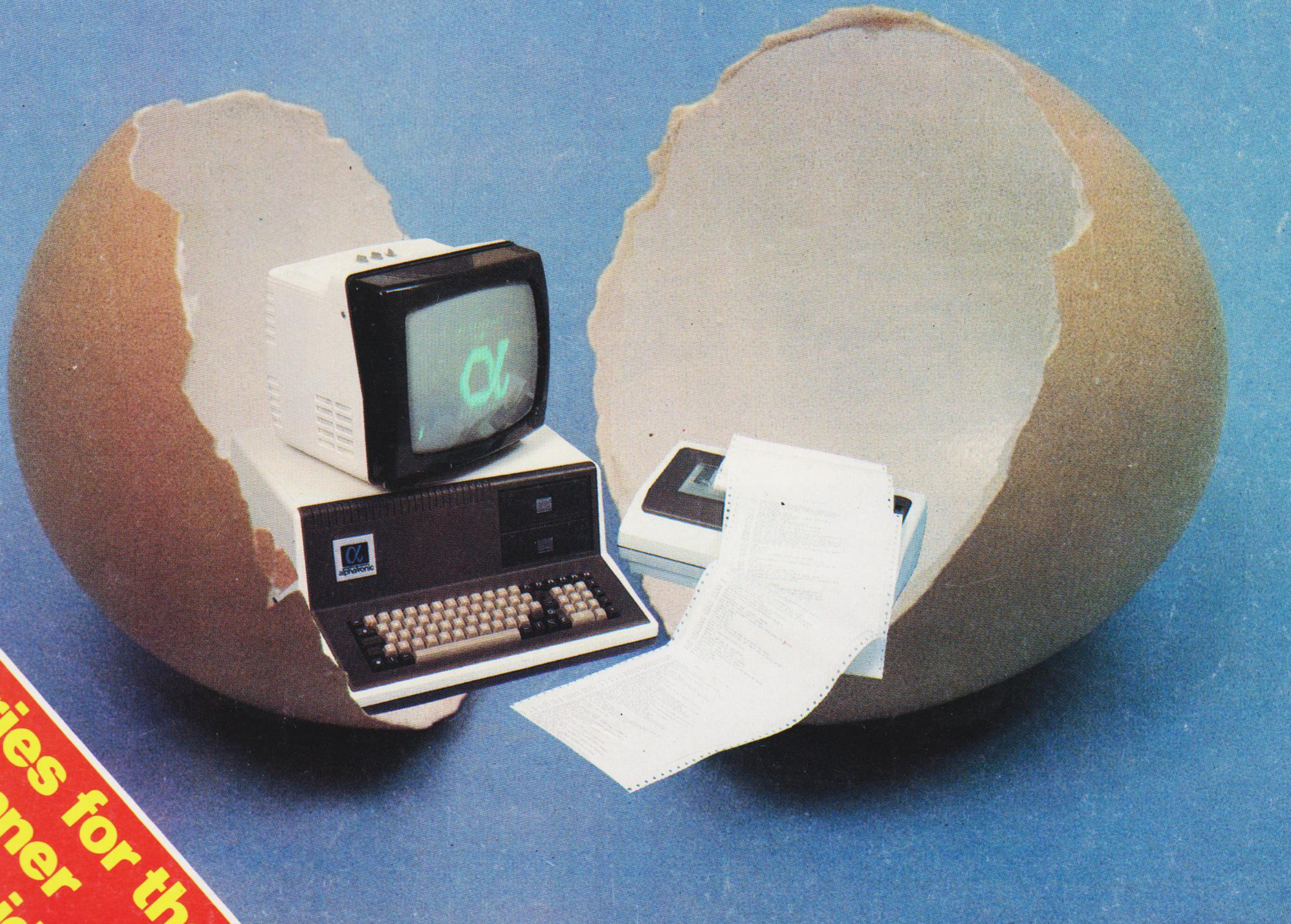

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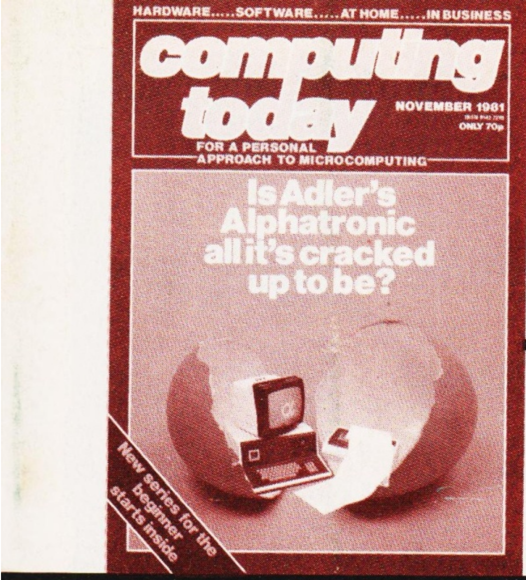

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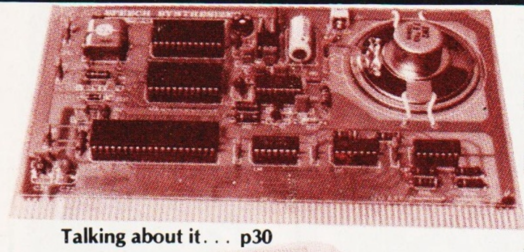

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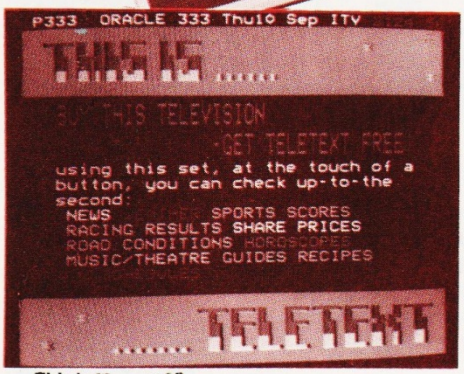

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Computing Today is constantly on the look-out for well written articles and programs. If you think that your efforts meet our standards please feel free to submit your work to us for consideration.

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

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

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Silicon Chip

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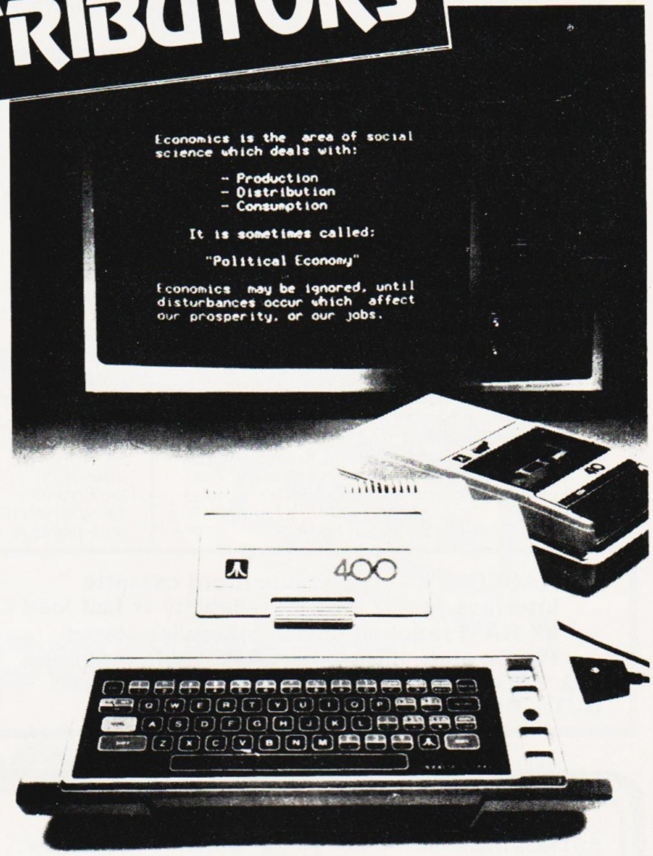

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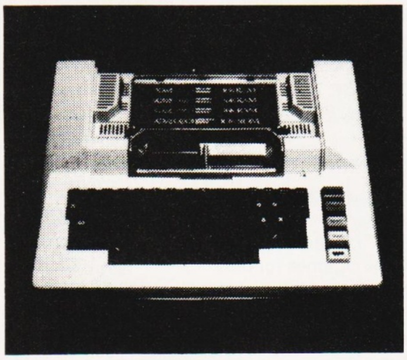

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IMPORTANT NOTICE

As of today, Monday 7th September, our parent company will be known as Argus Specialist Publications Limited. The previous name of Modmags Limited is no longer in use and all correspondence, cheques for subscriptions etc and references to the company should change to the new name. For convenience when writing out cheques and Postal Orders the name may be abbreviated to ASP Ltd. To ensure as smooth a changeover as possible can you please ensure that all material sent to our magazine carries the name of the new company. Your assistance in this is greatly appreciated.

TUG OFF!

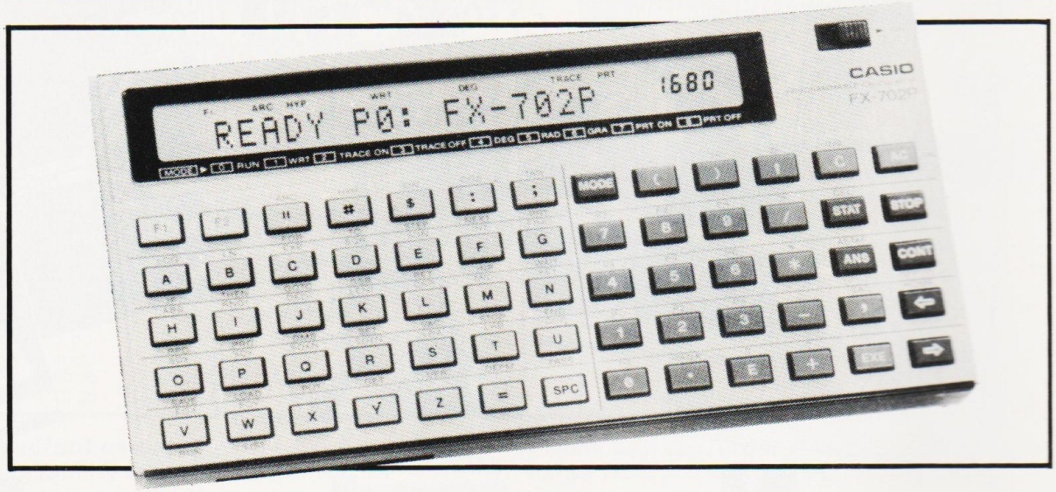
An announcement has just been received from Tangerine Computers concerning their relationship with the Tangerine Users' Group. They are withdrawing all discount facilities for TUG members and setting up their own in-house User Group which will communicate through a bi-monthly magazine called the 'Tansoft Gazette'. This will, initially, be distributed free of charge to all existing owners. At the time of going to press no comment on the situation had been received from Bob Green, the original instigator of TUG.

GIVING IT TO THE PEOPLE

IT, in this case, is that topic on everybody's lips at the moment, Information Technology. The people who are giving IT away are a group of organisations who are interested in the way in which Prestel, that's the public viewdata service, can act as a public information system. Forty public-access sets are being installed for one year in Post Offices, information and advice centres, shops and the like in Gateshead, Kingston-upon-Thames and Brighton. The DOI is providing £65,000 towards the project which is being co-ordinated by the Consumer's Association and supervised by the Social Information Providers' Group. A number of public sets are available across the country for access to Prestel, mainly in local libraries, and for information on where your local set is contact either your local library staff or, if in London, the National Consumer Council.

BUILDING BRICKS

Leeds Polytechnic are running a competition with a 'microcomputer... similar to the one that will be used in the forthcoming series produced by the BBC' and three secondary cash prizes to be won. The entries should consist of a detailed specification for a software package that could be used by a manager in a building organisation, and almost anybody is eligible for entry. Full details and guidelines can be obtained from The School of Constructional Studies, Leeds Polytechnic, Brunswick Terrace, Leeds LS2 8BU. All entries must be in by 31 January 1982 and all correspondence should be marked 'Micro Competition'.



FULL OF EASTERN...

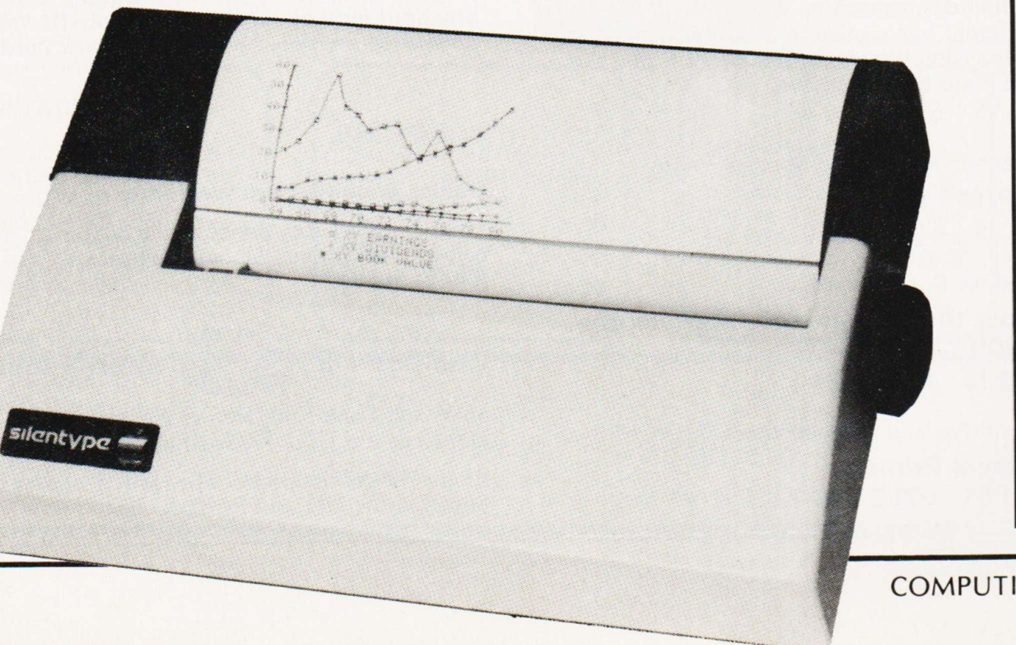
Latest in the long line of pocket programmable products from Casio is the new FX702P. This is not one of your ordinary pushbutton jobs, however — this is programmable in BASIC. If you think that you've heard that somewhere before you're quite right, as this is Casio's answer to the Sharp PC1211. It is certainly a very neat little product, ideal for the engineer or technician, and at £134.95 it offers slightly more than its rival. A printer and a cassette interface are promised for the end of the year and it also appears that additional memory units can be fitted in order to expand the supplied 1680 steps /26 memories. As is only to be expected the system is slow, approximately 20 seconds for a 1-1000 FOR...NEXT loop but that is a result of using CMOS processors with a power consumption of 0.01 W. Judging by the photograph many of the keys perform single key programming — for example, 'C' also offers the functions GOTO and EXP. Full statistical functions are built in, in addition to the usual mathematical operations. More details can be obtained from main Casio stockists or direct from Casio at 28 Scrutton Street, London EC2A 4TY.

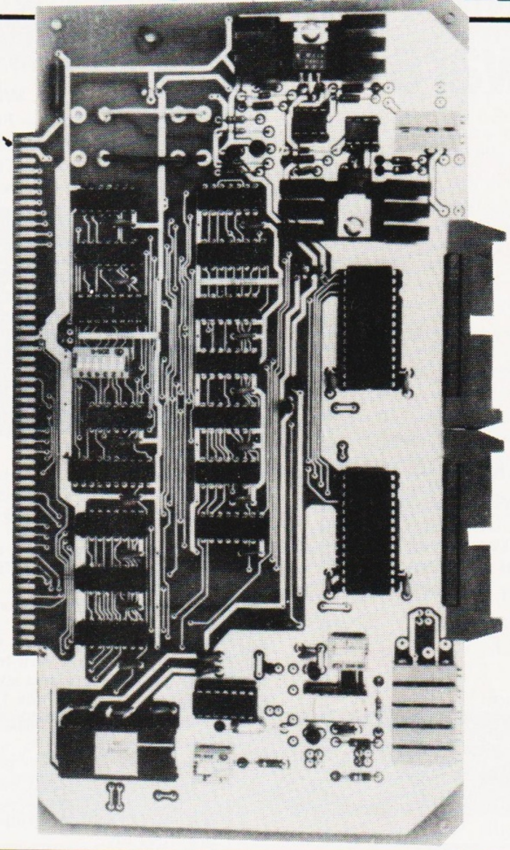
QUIET CUTS

In common with many of the other printers on the market these days, Apple's version of the Trendcom, called Silentype, has had its price chopped. At £203, apparently the 80-column thermal printer is supplied as standard with at least one in five of all systems purchased from the dealers. Microsense have also announced their new name, Apple Computer (UK) Ltd, which will come into effect after the takeover in October by Apple Computer Inc. Details of the Silentype and the whereabouts of your nearest official dealer can be obtained from Microsense at Finway Road, Hemel Hempstead, Herts HP2 7PS.

HELP REQUIRED

We have been approached by the research team of a well-known organisation who are currently preparing an independent report on applications of the microprocessor. They have asked us to ask you if you can help them. They want to know if you have or use a micro that is in any way connected to your home in a control situation. They are not looking for micro-controlled washing machines or doorbells but serious uses of computers in running a house more efficiently. Typical examples would be a computer-controlled security system, intelligent central heating and ventilation control, greenhouse management, full domestic monitoring, and the like. If you feel that you, or someone you know, has a system that fits into this kind of category please drop us a line giving brief details as to the type of micro and the functions it performs. Send your information to our normal address but mark your letters 'Micro Control Systems'. All information will be passed on to the research team and treated in the strictest confidence. Please do not expect an acknowledgement to your letter and do not include any other material with it as the research team won't know what to do with it! Our thanks for your co-operation.





GETTING CONVERTED

If you are searching for a professional specification A to D converter to fit your S100 system then Hall-Kentec's new AIM-12 might be of interest. The board has up to 32 single-ended inputs or 16 differential inputs with full scale voltages between 10 mV and 10 V. Resolution and accuracy are to 12 bits and each board can be addressed by means of DIP switches to suit various systems. In order to cope with low level signals from devices such as thermocouples and strain gauges an on-board precision amplifier is fitted. The unit costs £545 and information can be obtained from Hall-Kentec at 2 Greystones Close, Kemsing, Sevenoaks, Kent TN15 6QP.

COTTAGE INDUSTRY

Deep in the heart of the West Country, a mere welly-throw from my own front door, is a medium-sized town that goes by the name of Crediton. Life is peaceful there — a train calls about six times a day, buses are always on time, and the air is heavy with the gentle smells of the countryside and the occasional waft of fibreglass resin from the canoe factory. This rural tranquility has been somewhat shattered of late by the arrival of New Technology! To wit, one firm under the name of Willow Software. And just what do they have to offer? To be precise, a chunk of plastic encapsulated silicon which carries the name of Utility ROM, Acorn ATOM for the plugging into of. And, much as you would expect, it's a programmer's aid along the lines of our faithful toolkits. Plugging straight into the ATOM it offers: Renumbering, Auto line-numbering, Character finding, Bulk deletion, Program compression, True keyboard scanning, Auto-RUN loading, Keyboard sounder, and some nine other commands and functions. At a price of £35, which includes an instruction manual, it certainly seems a good buy. Anyway, how else could you get a piece of the country so cheaply? Contact Willow at PO Box 6, Crediton, Devon EX17 1DL.

TOLD YOU SO!

Back in May, when we brought you the news of Clive Sinclair's ZX81, we speculated — nay, predicted — that W H Smith would be selling the system before long. Although this was denied at that time by Sinclair, our predictions are now vindicated. As of September 1st, some 100-plus shops in the W H Smith chain are stocking the ZX81 under a five-month contract. Over 300 staff have been specially trained to answer questions on the system and to provide an after-sales service. Sinclair Research will continue to supply the ZX81 by mail order, and the printer and kit versions will be available only from them until the operation has proved to be a success. Unfortunately no indication has been given of the locations of these specialist branches bu they will undoubtedly be the major ones. Sinclair have also officially announced the availability of their ZX81 compatible printer at £49.95 inclusive of VAT.

SIMPLE SIDNEY

If you fancy colour graphics with your S100 system then Hi-tech would undoubtedly like you to consider their latest offerings. Designated SID1 and 2 (that stands for Simple Image Display, by the way), they cost under £400 and are supplied with documentation and graphics software. The screen format is configured on a 312 by 290 matrix with each pixel requiring three bits plus one shared bit with its neighbour. Each of the 90480 individual points can be defined in one of eight colours and the character size is dependent on the number of dots used: a 5 by 78 character on a 6 by 10 block would give 28 rows of 52 characters, for example. The SID2 board offers similar features but on a 340 by 290 matrix. Connection requires three ports and these are switch addressable to any four port boundary in the map. If you want more information drop a line to Hi-tech at 54 High Road, Swaythling, Southampton, Hants SO2 2JF or ring them on 0703-581555.

KLEPTOMANIA RULES

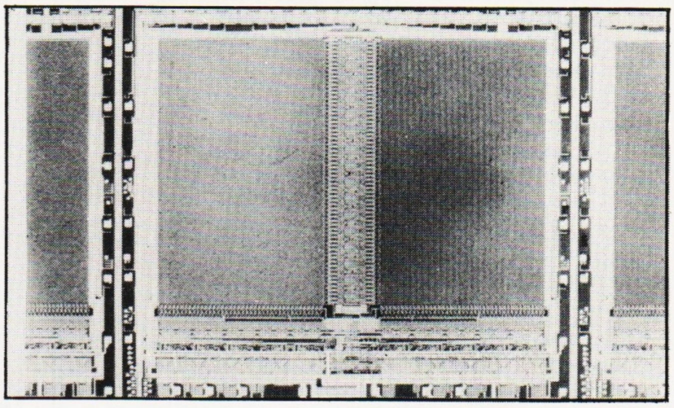
During the evening of Wednesday September 9th, while the Personal Computer World Show was being set-up, a DAI Personal Computer was lifted from their stand. The serial number of the machine is D-0-1677 and is located on a plate on the power supply cover. If anyone tries to sell or part exchange this machine Data Applications would be most interested to hear about it. The funny thing, if you can describe theft as funny, is that the system stolen has no manuals, no connecting leads and is a special RGB monitor version. To get it to work will set the thief back some £300 for a colour monitor! Data Applications can be contacted at 16b Dyer Street, Cirencester, Gloucestershire GL7 2PF or you could ring them on 0285-61902.

TANGERINE EXPAND AT LAST

Over a year since the successful introduction of their Microtan 65 system and its bigger brother, the Micron, Tangerine are at last bringing out the serious expansion products. Scheduled for September launch are a High-Res (256 x 256) graphics card at £79, a single-board controller which is effectively Microtan plus Tanex without the video output from £60, a 32K RAM card for £100 and a 32K ROM card at £47.52 excluding the ROMs (all prices are excluding VAT). All the cards plug directly into the motherboard. Also scheduled for an Autumn release is the long-awaited disc controller which will be offered with CP/M as an option. All orders are being dealt with in strict rotation so if you've been waiting a long time you should soon have something. Technical information on the above can be obtained from Tangerine Computers at Forehill Works, Forehill, Ely, Cambs CB7 4AE.

ROBOTIC RULES

The Amateur Computing Club are holding a seminar on the subject of Robotics at Imperial College, London on Saturday 28th November between 10 am and 5 pm. The subject of the MicroMouse contests will also be discussed and it is hoped to have some of the designers present. The day's entertainment will cost £9.50 and all enquiries should be addressed to Vernon Gifford, ACC liaison Officer, 111 Selhurst Road, London SE25 6LH.



A BIT BIG!

Talk about packing 'em in. Mostek are now taking orders for their 64K EPROM, that's 8K by 8 or a complete version of Microsoft crammed into one 28-pin device. Three access times are currently available; 500, 550 and 600 nS although times down to 250 nS will be available later. For high production runs a compatible mask-programmable device is available, known as the MK37000. For a data sheet on the product write to Mostek UK, Masons House, 1 Valley Drive, Kingsbury Road, London NW9.

BUG BYTES

Only one little problem seems to have arisen in the October issue and that's in the Text Compression article. In the second program the variable declared as Sl at line 30040 should, of course, be S1$! And, unless you've found anything else, that appears to be that. One minor problem that might crop up in this issue though is the representation of the 'star' in the Heavenly Bodies program. Despite having the code independently checked it appears that the shape produced is not quite right. If it offends your sense of aesthetics, please feel free to change it!

STOP PRESS

Despite the confident announcement in BUG BYTES, see the CONSUMER NEWS section, there appears to be a gremlin lurking in the Pools Prediction program. The DATA statement for the Third Division should have the extra comma before CHESTER removed and have SWINDON inserted immediately after SOUTHEND; you'll need to add a comma here. In line 4020 a pair of quotes have dropped off after the equals sign. Line 9540 requires that a RETURN be added before the REM. The author has also discovered a minor bug in the logic, the statement in line 3070 should read IF I = 5 THEN RETURN. Apologies to punters.

ON COURSE

The latest information on PTRC's 1982 educational programme has just been announced. Four computer oriented sessions are included: Microcomputer Systems for Engineers and Planners on 2nd/3rd February, Effective Use of Microcomputers on 4th/5th February, Data Base Concepts for Public Authorities on 9th/10th February and Effective Use of FORTRAN on 11th/12th February. Cost is £240 for non-members and £190 for members. For a complete leaflet on all these and the many others run by PTRC write to Sally Scarlett, PTRC Education and Research Services Ltd, 110 The Strand, London WC2 or ring on 01-836 2208.

TRANSAM GO SOFT

A couple of months after the launch of their new hardware catalogue, Transam have produced its software counterpart. Containing a variety of products from word processors to development and utility software at prices from £1,200 down to £30, they all run under CP/M and are mainly configured for the various versions of the Tuscan system. Once again the dear old Triton appears to have slipped from grace but, as it runs CP/M, most of the software should operate on this system. For your copy drop Transam a line at 59/61 Theobald's Road, London WC1 or ring on 01-405 5240.

A PACKAGE FOR THE 80s

Probably the most successful way to attempt a break-in to the small business market is to ensure that the computer you supply is backed with sufficient software. Terodec seem to be taking this approach with their new system, called the PBM-1000. California designed and built, the system features 80K of RAM, a 5" Winchester disc with a 5¼" floppy as back-up, DMA transfers for high-speed operation and CP/M 2.2. It is hoped that the system will be built in this country at a later date. A complete system with discs, VDU and printer will set you back some £6,000 and that includes a number of software packages. Their software range includes that produced by the Graham-Dorian Software Systems catalogue together with several packages from the US including one called Pearl which comes from Computer Pathways Unlimited and is a program generating program. Information on the system can be obtained from Terodec at Unit 58, Sutton's Park Avenue, Earley, Reading, Berkshire RG6 1AZ.

GOING HARD

Yet another major distributor in the UK is handling the up-and-coming Winchester Technology hard discs. These are the 5¼" Tandon drives and the sole UK source is Hal Computers of Weybridge. Designated the TM600 family, the drives are available in one, two or three platter formats and the storage capacities vary between 3.19Mb and 11.5Mb unformatted data. There is also a choice of 230 and 153 cylinders (tracks) per platter. Up to four of the units may be daisy-chained providing a total of some 46Mb of unformatted storage. A choice of interfaces is also offered: the S version is compatible with the higher capacity drives, the T version with the TM100 series of mini-floppies. For further information contact Hal Computers at 57 Woodham Lane, New Haw, Weybridge, Surrey KT15 3NJ or ring on 0932-48346.

IBM YOUR TRS

Hailed as offering the functions of an IBM VM/370 on a TRS-80, or at least the functions of its text editor, is a new wordprocessing package from Logical Choice called Newscript. Priced at £79.95 with a hardware requirement of 48K and one disc, it offers such features as global search and replace, full screen editing, right justification, underlining, emphasising and more. For £10 less its smaller brother, Subscript, requires only 32K but does not support full screen editing. Information can be obtained from the company at 261 Queens Road, Maidstone, Kent ME16 0LB or by ringing 0622-679437.

LATE EXTRA

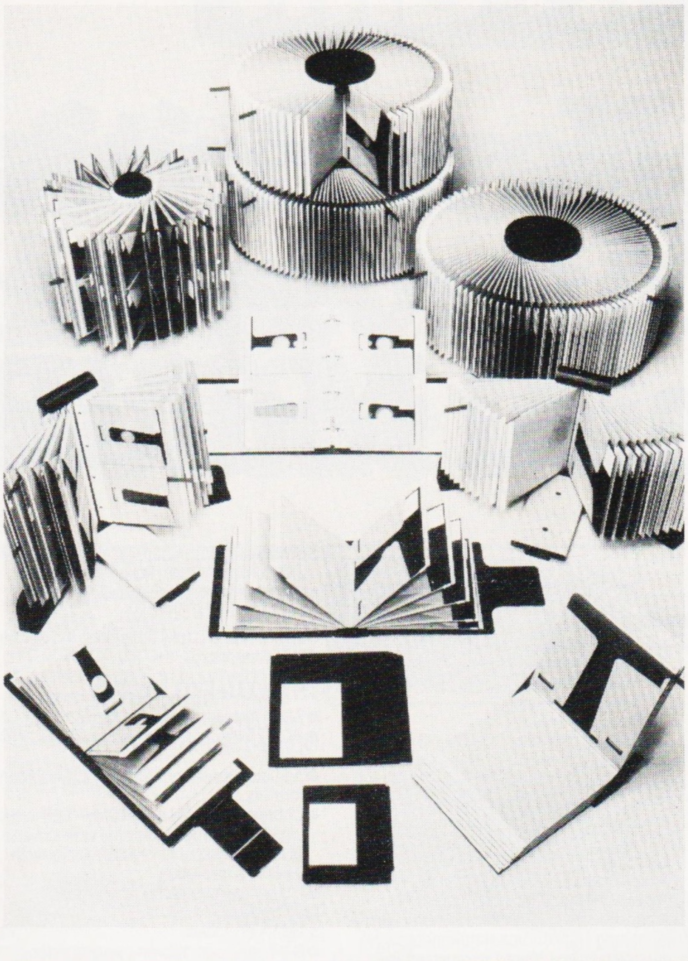
Coming just too late to be included in the list of software available on the Alphatronic system that is reviewed elsewhere in this issue is a package from Overseas Computer Systems Consultants. Originally written for accountants, the program suite offers payroll and incomplete record accounting facilities and is aimed at the small business market or the practising accountant. The software can be tailored by the user and includes links to a word processor facility for the addition of report notes etc. The hardware requirement is a 48K Alphatronic with twin floppies and printer, and if you are one of the first 50 people to buy the hardware from their Watford showroom you'll get the software free. The package will normally sell for £750 and this includes the CPM licence, a DMS package and training but you can also lease for around £17 per week. For more information contact OCSC at 182a Queens Road, Watford, Herts or ring them on Watford 48580.

PLANNING FOR THE FUTURE

As an added incentive for Information Technology Year, Philips Business Systems are holding a competition to design the interior for 'the office of the future'. A prize fund of £2,000 has been put up with the first prize taking £1,000 of that. The competition is open to Fellows, Members, Associates, Licentiates and Diploma members of the SIAD and full-time students currently registered CNAA and on SIAD recognised interior design courses. Full information can be received by writing to The Society of Industrial Artists and Designers, 12 Carlton House Terrace, London SW1. Entry forms will be available from October 1st and all entries must be submitted by December 21st. Please mark your correspondence 'Office of the Future Competition'.

DOUBLING UP

Yet another supplier of office sundries and computer media has launched their new catalogue — this time it's Ofrex. The new, fully illustrated catalogue contains some 3,500 product lines, twice as many as their last offering, and is crammed with tapes, discs, stationery, files furniture and the like for DP managers to drool over. Prices seem reasonable and the service offered appears to be excellent. If you are not already on their catalogue list drop them a line at Ofrex House, Stephen Street, London W1A 1EA.



FILES AND FLOPPIES

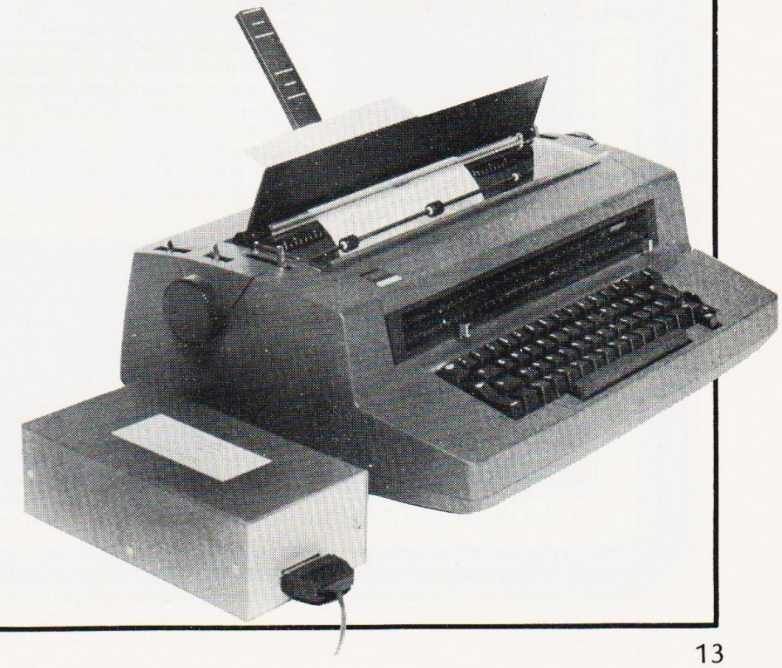
One of the more well-established names in office equipment has entered the electronic office era with its own floppy discs and storage systems. Twinlock are now marketing 5¼" and 8" discs through stationery and office equipment outlets together with filing systems for both these and microfiches(?!). The discs are being made for Twinlock by CDC and will be available in packs of 10 at a 'competitive price'. The new filing systems are desk, wall or floor mounting and include rotary files, binders and easels for rapid selection. For further information consult your local Twinlock stockist or contact them direct at 36 Croydon Road, Beckenham, Kent.

ESPECIALLY FOR ADAM

The Computer Retailers' Association has actually made a move to secure the careful marketing of a piece of hardware before that equipement has actually reached these shores. The computer is the Osborne, the portable system produced by Adam Osborne who is probably better known in this country for his books. A new group of those CRA dealers who have been appointed Osborne dealers was brought into existence last week, just as PET, Apple, etc groups have been set up in the past. Only one Osborne dealer is not currently a CRA member. For further information on the CRA and its various activities write to The Secretary, Computer Retailers' Association, Owles Hall, Buntingford, Herts SG9 9PL.

QUALITY OUTPUT

Many offices that are considering the changeover to become 'electronic' have a big shock when they discover that their high quality printer is going to set them back the best part of £2,000. If they have any IBM golfball typewriters lying around, they could save a substantial amount by using these as output devices. One of the interface units being produced, that's the piece of electronics that goes between the computer and your golfball, is known as the Escon and currently sell for around £415. More information on the product is available from DataRite Terminals of Caldare House, 144-146 High Road, Chadwell Heath, Essex RM6 6NT. One worthwhile point to note is that the typewriter still behaves as such, and you therefore get two units for the cost of one interface.



David M Jones

Byte by byte, bit by bit

A facility to test thoroughly any area of RAM memory in a system is a reassuring thing to have available. For example, on upgrading my Microtan 65 to include BASIC, I found that using one particular function caused corruption in a certain area. Suspecting faulty BASIC chips, I asked Tangerine to exchange them for another set. This was done unquestioningly, but with the comment that it sounded more like a memory fault; so when I found that the fault persisted even with my new set of BASIC chips, I decided to write a simple utility to test memory byte by byte.

The first simple version enabled me to identify the dodgy chip immediately. In fact the problem was due to one of the legs being tarnished slightly; gentle cleaning and re-insertion cured everything!

Encouraged by this, I determined to produced a foolproof, flexible version which would not only test the memory but also restore each byte to its original value after testing it. This enables one to run the test at any time without sacrificing the current contents of memory (at least from page 2 upwards). In addition, in the case of failure, details of the data written and read back are displayed and one is given various choices of action to take, as explained later.

As I continue to expand my system, I routinely test each new memory chip and can then rest assured that it has been thoroughly exercised before being relied on for anything more critical.

MEMTEST was written specifically for the Micron/Microtan 65 system and uses subroutines resident within the monitor (TANBUG) to facilitate input and display. However, the operation of the main loop of the program should be self-evident, enabling anyone with knowledge of 6502 machine code to modify the input and display to suit their particular 6502-based system.

MEMTEST itself resides in the area from 0060H up to 01A5H thus keeping well clear of the extent of the stack which is generated when it runs.

Program Description

The test consists of writing, reading back, and comparing every possible bit combination represented by hexadecimal 00 up to FF; this is done for every location of every page for the range specified at the start of the test. Any discrepancy in the comparison results in a failure report as detailed below. The purpose of testing every bit combination, rather than just all zeros followed by all ones, is to highlight the so-called 'soft' errors which apparently can occur on only certainly bit patterns and which would be missed by the 'all on, all off' type of test.

It is also self-protective, in that it will not allow the test to be run on page 0 or page 1, for the obvious reason that the resultant corruption to TANBUG work-areas, the test program itself, and the stack would be fatal. However, the test can be run through pages 2 and 3 (the screen area) and can thus actually be seen in operation, providing that every location in a page is addressed and correctly restored.

A further reassurance that the test is actually in progress is provided by a counter running in the bottom left-hand corner of the screen, which shows the address of the location currently being tested. This counter stops when a failure is detected, or when the test is completed, displaying the address reached.

Failure Report

A failure report consists of a display of the address at which failure occurred, the Hex character which it attempted to write, and the character read back. The cursor is displayed under the column heading 'ACT' (short for 'action') and invites one to take one of four possible actions as follows:

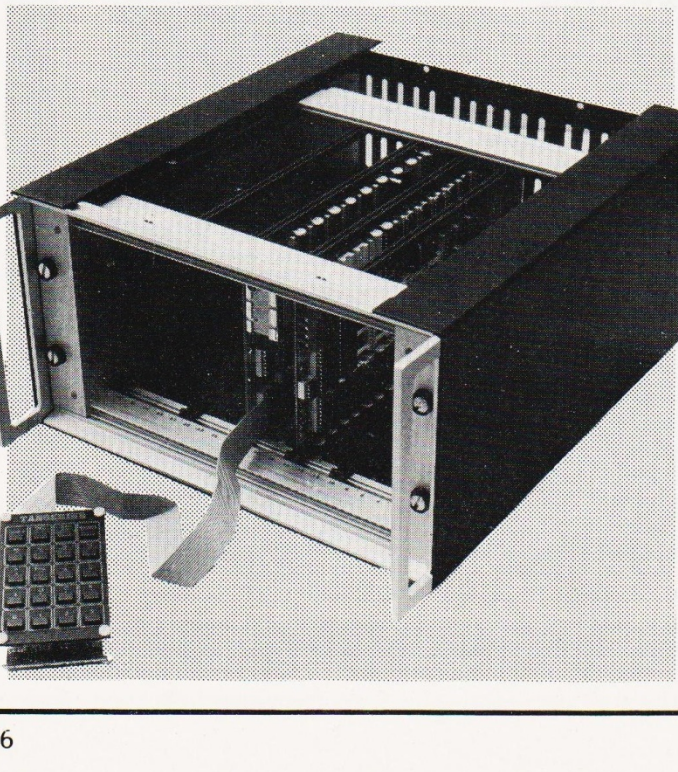
Enter 0 to repeat the test with the *same* bit combination at the same location.

1 to increment the bit combination by 1 and continue the test at the same location.

2 to abandon the test of this location and start the test on the next one.

3 to abandon the test completely and restart the program.

Successful completion is indicated by 'END' being displayed, and control is returned to TANBUG. The time taken for the test to run is approximately 10 S per kilobyte.



Program Listing

Initialisation

```
0060  20  73  FE  JSR  $FE73    OUTPCR
  63  A2  00      LDX  #$00     set start of message
  65  A9  16      LDA  #$16     set finish
  67  85  40      STA  $40
  69  20  60  01  JSR  $160     DISPLAY S/R
                                ("FROM PAGE")
  6C  20  33  01  JSR  $133     READ S/R
  6F  A5  40      LDA  $40      get page no. (from)
  71  85  41      STA  $41      store it
  73  A2  15      LDX  #$15     set start of message
  75  A9  20      LDA  #$20     set finish
  77  85  40      STA  $40
  79  20  60  01  JSR  $160     DISPLAY S/R ("TO
                                PAGE")
  7C  20  33  01  JSR  $133     READ S/R
  7F  A5  40      LDA  $40      get page no. (to)
  81  85  43      STA  $43      store it
  83  A2  1F      LDX  #$1F     set start
  85  A9  2F      LDA  #$2F     set finish
  87  85  40      STA  $40
  89  20  60  01  JSR  $160     DISPLAY S/R
                                ("ADDR" etc.)
```

```
  8C  A5  41       LDA   $41        get page no. (from)
  8E  20  0B   FF  JSR   $FF0B      HEXPNT
  91  A9  00       LDA   #$00       zero "units" from and
                                    to
  93  85  40       STA   $40
  95  85  42       STA   $42
```

Main Loop

```
0097  A0  FF       LDY   $FF
  99  C8           INY
  9A  98           TYA
  9B  20  0B   FF  JSR   $FF0B      HEXPNT "units"
  9E  B1  40       LDA   ($40),Y    get character
 AA0  85  44       STA   $44        save it
  A2  A9  00       LDA   #$00       set bit pattern to zeros
  A4  85  45       STA   $45        store it
  A6  91  40       STA   ($40),Y    store bit pattern in
                                    location
  A8  B1  40       LDA   ($40),Y    get it back
  AA  C5  45       CMP   $45        compare it
  AC  D0  26       BNE   $D4        branch if fail
  AE  E6  45       INC   $45        increment bit pattern
  B0  A5  45       LDA   $45        get it
  B2  D0  F2       BNE   $46        next if no limit
  B4  A5  44       LDA   $44        get back character
  B6  91  40       STA   ($40),Y    restore it
  B8  C6  03       DEC   $03        adjust cursor position
  BA  C6  03       DEC   $03        adjust cursor position
  BC  C0  FF       CPY   #$FF       end of page?
  BE  D0  D9       BNE   $99        next if not
  C0  A5  41       LDA   $41        get page no
  C2  C5  43       CMP   $43        last page?
  C4  F0  5A       BEQ   $120       branch if last
  C6  C6  03       DEC   $03        adjust cursor position
  C8  C6  03       DEC   $30        adjust cursor postion
  CA  E6  41       INC   $41        increment page no
  CC  A5  41       LDA   $41        get page no
  CE  20  0B   FF  JSR   $FF0B      HEXPNT
  D1  4C  97   00  JMP   $97        loop back
```

Fail

```
00D4  84  48       STY   $48        save Y
  D6  85  46       STA   $46        save pattern read
  D8  20  6C   01  JSR   $16C       OUTPSP (space)
  DB  A5  45       LDA   $45        get pattern written
  DD  20  0B   FF  JSR   $FF0B      HEXPNT (display it)
  E0  20  6C   01  JSR   $16C       OUTPSP (space)
  E3  A5  46       LDA   $46        get pattern read
  E5  20  0B   FF  JSR   $FF0B      HEXPNT (display it)
  E8  20  6C   01  JSR   $16C       OUTPSP (space)
  EB  20  6C   01  JSR   $16C       OUTPSP (space)
  EE  20  FA   FD  JSR   $FDFA      POLLKB (enter action
                                    code)
  F1  A5  01       LDA   $01        get character entered
  F3  C9  30       CMP   #$30       compare to ASCII "0"
  F5  90  F7       BCC   $EE        ignore if less than
  F7  C9  34       CMP   #$34       compare to ASCII "4"
  F9  B0  F3       BCS   $EE        ignore if "4" or
                                    greater
  FB  85  47       STA   $47        save action code
  FD  20  75   FE  JSR   $FE75      OPCHR (display it)
0100  20  73   FE  JSR   $FE73      OUTPCR (line feed)
  03  A5  41       LDA   $41        get page number
  05  20  0B   FF  JSR   $FF0B      HEXPNT (display it)
  08  A5  48       LDA   $48        get "units" of address
  0A  20  0B   FF  JSR   $FF0B      HEXPNT (display it)
  0D  A4  48       LDY   $48        restore Y
  0F  A5  47       LDA   $47        get action code
  11  C9  30       CMP   #$30       was it "0"?
  13  F0  91       BEQ   $A6        if so, repeat pattern
  15  C9  31       CMP   #$31       was it "1"?
  17  F0  95       BEQ   $AE        if so increment
                                    pattern
0119  C9  32       CMP   #$32       was it "2"?
  1B  F0  97       BEQ   $B4        if so, start next
                                    location
  1D  4C  60   00  JMP   $60        otherwise repeat run
```

End

```
0120  98           TYA              get Y
  21  20  0B   FF  JSR   $FF0B      HEXPNT (display it)
  24  A2  2E       LDX   #$2E       set start
  26  A9  34       LDA   #$34       set finish
  28  85  40       STA   $40
  2A  20  60   01  JSR   $160       DISPLAY S/R
                                    ("END")
  2D  4C  00   FC  JMP   $FC00      return to TANBUG
```

Read S/R

```
0130  20  75   FE  JSR   $FE75      OPCHR
  33  20  FA   FD  JSR   $FAFD      POLLKB (read
                                    character from k/b)
  36  A5  01       LDA   $01        get character
  38  C9  0D       CMP   #$0D       was it CR?
  3A  D0  F4       BNE   $130       if not, return for
                                    another
  3C  A0  09       LDY   #$09       set position for pick
                                    up
  3E  20  28   FF  JSR   $FF28      HEXPCK
  41  A5  13       LDA   $13        get last two digits
  43  C9  02       CMP   #$02       O.K. if "2" or greater
  45  B0  02       BCS   $149
  47  A9  02       LDA   #$02       otherwise, default to
                                    "2"
  49  85  40       STA   $40        store page number
  4B  A9  0A       LDA   #$0A       set output position
  4D  85  03       STA   $03
  4F  A5  40       LDA   $40        get page number
  51  20  0B   FF  JSR   $FF0B      HEXPNT (display it)
  54  A9  20       LDA   #$20       load space
  56  20  75   FE  JSR   $FE75      OPCHR (display it)
  59  A5  03       LDA   $03        get cursor position
  5B  C9  1F       CMP   #$1F       end of line?
  5D  D0  F5       BNE   $154       space fill line
  5F  60           RTS
```

Display S/R

```
0160  BD  72   01  LDA   $172,X     get character
  63  20  75   FE  JSR   $FE75      OPCHR (display it)
  66  E8           INX
  67  E4  40       CPX   $40        test for limit
  69  D0  F5       BNE   $160       if not, return for next
  6B  60           RTS
```

OUTPSP S/R (output space)

```
016C  A9  20       LDA   #$20       load space
  6E  20  75   FE  JSR   $FE75      OPCHR (display it)
  71  60           RTS
```

Alpha Data

```
0172  4D  45  4D  4F    MEMO
  76  52  59  20  54    RY T
  7A  45  53  54  0D    EST
  7E  46  52  4F  4D    FROM
  82  20  50  41  47    PAG
  86  45  20  20  20    E
  8A  54  4F  20  50    TO P
  8E  41  47  45  20    AGE
  92  41  44  44  52    ADDR
  96  20  57  52  20    WR
  9A  52  44  20  41    RD A
  9E  43  54  0D  45    CT E
  A2  4E  44  0D  0D    ND
```

Work Area

40	finish of alpha, then zeroised
41	page number (from)
42	must be zero
43	page number (to)
44	saved character
45	bit pattern written
46	bit pattern read back
47	saved action code
48	copy of Y

computing today

DECEMBER 1981
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COMPUTING TODAY · NEXT MONTH

DOSSING DOWN?

This feature could be better described as 'one man's fight against the system', or even, 'how not to knuckle under when your DOS dies!' As you may have already guessed this is the story, with the software to prove it, of one individual's desperate fight to replace his old and dying DOS. The system is NASCOM, the routines are universal — you can re-write them into whatever machine code you wish — and the result is superb. So, if your discs are down in the mouth as a result of an unusable DOS, cheer them up with our next issue.

TRIED AND TRUSTED

Many of the original breed of personal computers have been slowly upgraded or replaced over the years. Not so the Exidy Sorcerer — despite a rather bleak period it's still with us. Continuing our series of re-reviews of popular machines we take a long look at this grand old system through the eyes of a family of dedicated users. Their findings may well come as a suprise!

TECHNOLOGY TAKES OVER

Over the next 12 months you are going to hear an awful lot about Information Technology, what IT is, what IT does and how IT is going to affect your lives. Information Technology is already here and working. In this issue we've spoken about the Teletext system, and next month we'll be going over the inner workings of the Prestel system, Britain's leading example of IT. Prepare yourself for the next year — order next month's issue today.

COMPUTERS IN THE CLASSROOM

People often talk about the numbers, or rather the lack of them, where computers for schools are concerned. However, there don't seem to be any hard and fast facts to bear out the story on either side. No facts until now, that is. Computing Today has the result of an independent survey of the various educational and local authorities around the country and we'll reveal all next month.

AND THE REST

As if the above were not enough to tempt you, the next issue will also contain a full digital storage 'scope simulator for the classroom, routines to explain how computers crunch numbers, a simple statistics calculator, programs to pack your data tapes more thoroughly and all the usual features that you expect to see each month. A bumper bundle and all for less than the cost of a couple of pints!

Articles described here are in an advanced state of preparation but circumstances may dictate changes to the final contents.

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COMPUTING TODAY · NEXT

the vic centre

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

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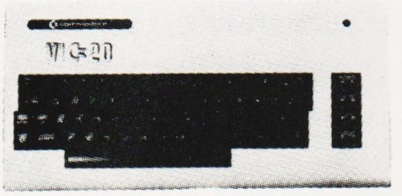

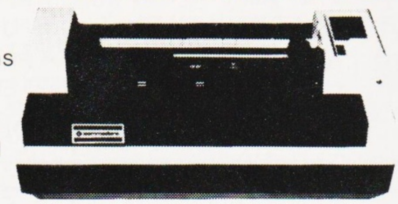

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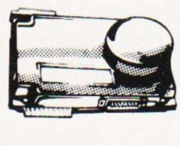

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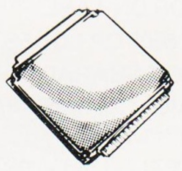

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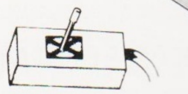

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Peter Freebrey

If you're taking the first tentative steps towards micros then you need all the help you can get. This is the place to come each month for advice

A beginner s guide to programming the microcomputer. Easy, you say — start at the beginning, work through the middle and finish neatly at the end. Have you ever read a good introduction to computers that has clearly explained to the raw novice what he wants to know, in a manner that he can understand? Many books/articles have been written in the past which, in my opinion, quickly got bogged down in either (a) attempting to explain what goes on in and among the silicon chips themselves, or (b) losing the noviciate in a welter of binary code or some form of assembly language.

Worse still is the expert who genuinely knows a great deal about the subject but who baffles us right from the beginning because he is unable to comprehend that anyone could have so little knowledge. Let us also make it quite clear right from the start that although programming may have a beginning and a middle, you never end the process of learning. The most experienced computer programmer will always find new ideas or methods turning up to add to his programming skills.

These articles will not be using any of these approaches, they really are aimed at the novice. Hopefully, we will occasionally introduce a small program or subroutine that might also have a wider appeal. One thing to remember about this subject is that however long you have been reading Computing Today or writing programs, there are always new ways to see old problems.

Although this series has a planned pattern that we think will explain the basic principles of programing the microcomputer we would be very pleased to receive your letters concering your viewpoints. I can assure you that you will never receive an answer. . . through the post, that is! Also, I can assure you that all your letters will be read and perhaps incorporated in this series. Just work on the assumption that to buy Computing Today must mean that you are of reasonable intelligence. Therefore, if something seems unclear to you it must be downright foggy to many others — so write in and tell us.

In The Beginning. . .

What is a computer? What can it do? Questions so often asked, and the answers so rarely understood. Here are some simple answers:

What is a computer? A computer is a device which can be told (programed) to perform simple arithmetic. It has the ability to remember what it has been told, and has some means of telling you the answers to the questions it has been asked.

What can it do? Let us assume now that the sort of computer we are discussing is the type most often found in these pages. It will be electronic (rather than mechanical), and it will display information on a monitor or television screen. It will also have a means by which you can communicate with it, probably a keyboard rather like that of a typewriter.

The computer does not have life of its own, it is not able to do anything by itself — it must be told what to do. When it is switched on and working, you can type anything you wish on the keys and this may or may not appear on the screen. You could type in 'What is 56 divided by 326?'. Nothing will happen until you press the Carriage Return or Enter keys. Unfortunately the computer is pretty dumb and does not speak quite the same language as you do, and it will not understand what is being asked of it. However, it is probably polite and friendly and will tell you it has not understood by displaying something like SYNTAX ERROR on its screen. Computers 'speak' a number of different languages — not French, German or Russian, but FORTRAN, ALGOL, BASIC and many others. For the purposes of these articles we will use the one that is most common among personal computers — BASIC. This name is an acronym made up from the initial letters of Beginners All-purpose Symbolic Instruction Code. The name is rather appropriate! The computer has a very small vocabulary. It only recognises about 100 'words' initially, so you should have no difficulty in learning to communicate with it. Having learnt how to 'talk' to the computer you can ask it to work out the answer to most calculations you think of, *but* you must know how to solve the calculation yourself. Remember that the computer can only do what it is told to do. However, it works very quickly and it can perform a calculation in seconds that would take you hours.

It can also recognise and draw on the screen the alphabet and a limited number of symbols, thus it can draw pictures. It can also be instructed to ask you questions and depending on the answer you give it, can make a decision on what to do next. But, it can only ask the questions and draw the pictures that you have told it to ask or draw.

Telling It What To Do

Let us summarise what we have just said. The computer:

1) Can perform certain arithmetic functions
2) Can be instructed in what to do using a simple language that it understands
3) Remembers what it has been told in that language
4) Can communicate (display results) with the user if instructed to do so.

For the computer to do anything at all it must be given instructions on what to do and also when to carry out those instructions. Instructing the computer on what to do is called programming and the set of instructions, however simple it may be, is called the program.

This program is fed (eaten . . . sometimes it seems that way!) to the computer, which then carries out the instructions it contains. BASIC requires that each instruction be preceded by a *line number*. Some dialects allow more than one instruction to follow a line number but a program *must* be written with line numbers. When the computer RUNs a program it always starts at the smallest line number and works through to the largest line number, unless specifically told within the program to jump to another part of the program.

The program may be keyed into the computer with 'out of sequence' line numbers but these will be sorted into their correct order within the computer . . . smallest to largest and the computer will always carry out the instructions in this order.

We can crudely summarise the steps taken in getting a simple program into the system:

1) *You* must know what *you* want the computer to do.
2) The computer must be given step by step instructions on what actions it must take
3) This program will be stored in the computer's memory in line number order
4) If you then tell the computer to RUN this program it will perform the instructions given in the program in line number order.

▷

The construction of programs and the implications of the computer's 'language' and 'grammar' are the foundations upon which you can build such diverse projects as calculating the flight characteristics of a space rocket, calculating how long it will take you to pay off your mortgage, or perhaps inventing a space invasion game!

It is our intention that these articles prepare the way for these possibilities by explaining the meaning and use of the most common language found on the microcomputer . . . BASIC. Like many spoken languages, BASIC has several 'dialects' depending upon the make of computer. But, just as BBC English is understood in all regions of the British Isles, we will attempt to make our BASIC instructions understood by all computers, regardless of creed, colour or make.

No-one would disagree that one of the best ways to learn what a computer can do is the 'hands-on' approach. This quite literally means getting your hands on a computer, keying in various instructions in the form of small programs and seeing what happens. Most computers have some sort of manual that tells the reader what BASIC words the computer recognises and what effect these instructions (statements, commands, keywords etc) will have when used in a program. Some manuals just assume you know all the implications and effects of such words. We will work our way through these instruction words hopefully filling in some of the gaps left by the poorer manuals and, hopefully, helping some of those who do not yet have access to a computer to get that valuable 'hands-on' experience.

Some Fundamentals

Before looking at the BASIC instruction words let us consider the keyboard. This will most probably look like a typewriter keyboard and will have the standard QWERTY arrangement of keys. It may additionally have the number keys set conveniently together at one side. Some computers give the option of a number of graphic symbols which are directly accessable via the keyboard.

There are three types of character on the keyboard:

1) Numeric. . . keys 0 to 9
2) Non-numeric. . . the alphabetical and graphic characters
3) Operators. . . these are symbols used by BASIC to perform arithmetic operations they are:

=	equals	(1 = 1)
+	addition	(2+3 = 5)
−	subtraction	(4−2 = 2)
/	division	(6/2 = 3)
*	multiplication	(2*4 = 8)
^	exponentiation	(2^3 = 8)
>	greater than	
<	less than	

There are two terms that should be understood from the beginning. They are:

(a) **Strings**: a string is a sequence of which may include operators but not quotation marks. Quotation marks (" ") define the beginning and end of a string. A string is a 'package' of information, usually non-numeric, and often represents text that will aid the understanding of displayed data. There are many interesting operations involving strings and we will deal with these later in the series.

Some examples of strings would be:

"TYPE RUN TO START"
"15TH JULY 1976"
"WHAT IS YOUR NAME"
"15-7-1976"

(b) **Variables**: are numerals or strings represented by a simple label to enable operations to be performed upon them or values assigned to them by merely referencing the label. Dialects of BASIC vary in what is allowed as a variable name. Some allow only a letter or a letter followed by a numeral, others additionally permit two letters, still others allow the use of many characters providing only letters of the alphabet are used. Variable names that refer to strings must be followed by a dollar sign ($). Examples of variable names would be:

A A1 BB A$ A1$ BB$ etc.

and on some machines:

"A LOAD OF EGGS WILL COST" etc.

The First Word

Having very briefly built up to the point when we can start talking about programming instruction words, the question is, which one? The most commonly used word is PRINT. This, like several other BASIC instructions, is a carryover from the past. Computers did not always have monitors or television screens as part of their regular equipment but used some form of electromechanical printer. Initially Teletypes were used these being followed by lineprinters and faster, more modern variants.

Anyway, back to PRINT. As you might expect PRINT implies the instruction to print or display something. The instruction consists of the word PRINT followed by the data to be displayed. This data may be strings, variables or the results of formulae. Most machines allow several items of such data to follow one PRINT statement but they *MUST* be separated by operators, in this case two special ones; commas and semi-colons.

Strings as previously mentioned, *MUST* be enclosed within quotation marks, which define the start and end of the specified text.

The following examples show some of the ways in which the basic PRINT function can be used to get information onto the screen of your system.

Try these, and any others you can think of, and next month I'll show you how to get things IN instead of OUT.

10 PRINT . . . outputs a blank line, if done repeatedly it will clear the screen

10 PRINT "THE ANSWER IS" . . . displays

THE ANSWER IS

10 PRINT A$ . . . displays the string assigned to A$, if A$ = "FRED", displays

FRED

10 PRINT X . . . displays the value of variable X, if X = 5.0 it displays

5.0

10 PRINT X,Y . . . displays the value of X followed by a number of spaces then the value of Y. The comma forces the next output (Y) to start some predetermined distance across the screen. It acts like a fixed TAB on a typewriter.

10 PRINT "MY NAME IS "; A$. . . displays

MY NAME IS FRED

(assuming that A$ = "FRED". The semi-colon makes the contents of A$ appear *next* to the previous output

10 PRINT 2+7+5−6 . . . displays

8

(ie the result of the equation)

10 PRINT X+Y+Z−B . . . displays the numerical result of the equation, if a variable has not been given a value most computers assume that value is zero.

Complex Functions

As this series is only intended for the beginner I have not tried to introduce, at this stage anyway, the other, more complex, PRINT functions.

Suffice to say that there are many other instances in which you may see PRINT used but, in all cases, the end result will be to display some information somewhere.

One (almost) universal alternative to PRINT is the Microsoft shorthand of ?. This saves you four letters-worth of typing and is automatically translated by the computer's internal software.

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Owen Bishop

Some systems don't provide a source of random numbers – this hardware substitute should suffice

We quite often use random numbers in programs, particularly in games, to introduce an element of chance. They are also important in certain statistical and mathematical programs. One of the simplest and cheapest true random number generators is a 1p coin. Simply toss it in the air and let it fall. Write down '0' if it falls 'tails' or '1' if it falls 'heads'. This gives you a random number in the range 0-1.

The criterion that distinguishes a random number from a non-random number is that, on each occasion, any number in the chosen range is *equally likely* to occur. We normally accept that tossing a coin has two equally likely results, head or tails. This makes it a true random-number generator. However, interfacing a penny to a micro is something that is likely to tax the abilities of even the most ingenious of electronic engineers. We have to look for some other random event that can be harnessed to our cause.

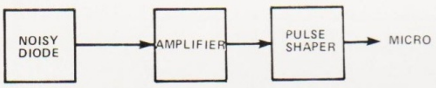

Fig. 1. The block diagram of the random number generator.

White Noise

Noise is the key to the true random number generator described in this article. The generator has three stages (Fig. 1). The first is centred on a reverse-biased 'noisy' diode. The random motion of electrons in the semiconductor causes random fluctuations in the voltage across the diode.

This provides a good basis for the generator and there is no problem with interfacing to the micro. The voltage fluctuations at the diode are only about 50 mV, peak-to-peak, so we feed them to an amplifier at the next stage. The amplifier signal goes to two CMOS inverters to square the waveform. The output of the second inverter is now either 'high' or 'low' and changes unpredictably and rapidly from one state to the other. This output can be fed to the microprocessor system.

Circuit Details

The diode specified in Fig. 2 is a special noise-generating diode. It is somewhat expensive as diodes go (just over £2) and it is possible to use an ordinary avalanche diode instead. A BZY88 9V1 zener diode has been found satisfactory, although it does not give such large voltage fluctuations as the Z5J it works well and costs much less. The high-frequency voltage changes are fed to the operational amplifier IC1 through the coupling capacitor C2. The amplifier is connected as a differential amplifier, it amplifies the difference between the signals at its two inputs. The voltage at its non-inverting input is fixed by adjusting RV1, with an effect that will be explained later. The inverters are made from two NOR gates with connected inputs. ZD1, a zener diode, limits the output voltage to a level compatible with the micro.

Since the amplifier operates on a split power supply and since the diode requires at least 15 V to bring it to its noisy condition it can not (generally) be powered from the micro system. The generator in most conveniently powered by two 9 V batteries.

Construction

Begin with the diode stage. If you have an oscilloscope connect the probe to point A. At low sweep rate the trace simply looks fuzzy, but at high rates it is possible to see the completely irregular (ie random) nature of the voltage changes. Next build the amplifier stage. To test this connect an oscilloscope to point B. Alternatively, connect a capacitor (100nF) and crystal earphone as shown by the dashed lines of Fig. 2. Adjust RV1 until you hear a fairly loud rushing noise. This is the amplified white noise of the diode, and sounds like a lorry-load of dried peas being poured steadily on to a corrugated iron roof. Finally, wire up IC2, remembering to connect the unused inputs (pins 8, 9, 12 and 13) to the negative supply. You should obtain the white noise in an earphone connected now to pin 4 of IC2. With the oscilloscope grounded on the 0 V line, the trace appears as two irregular lines (Fig. 3a). The upper line corresponds to a 'high' (+5 V) output, the lower line to a 'low' (0 V) output. The rapid transitions between these are not readily visible. If you slowly turn RV1, so that the amplifier and gates spend more time in one state and less in the other, the trace looks more like Fig. 3b or 3c. If RV1 is turned further, excursions to the less frequent state become increasingly rare.

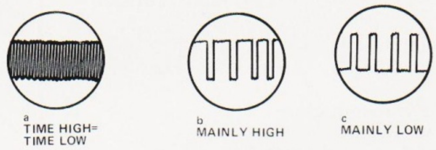

Fig. 3. Some typical oscilloscope waveforms.

Connections

Only two connections are needed. One goes to the 0 V rail of the micro system, and the other goes to a suitable input. With the Mk-14 use the SENSE A input (seventh pad from the right at the near end of the board). Figure 4 shows a three-pin plug but you can of course push your five-way socket on to this. The terminal arrangement is compatible with the connections to Thermoface (CT, May 1980). With Acorn, use input B0 of the I/O device (tenth contact from the rear on the right-hand end of the lower board — *not* the strip at the edge, but the plated 'hole' contact beside the strip).

Setting Up

To simulate a tossed coin we need to adjust RV1 so that the output of the generator is 'high' for 50% of the time and 'low' for the other 50% (ignoring transition time). This may be done visually, using a scope, by turning RV1 until the trace looks like Fig. 3a. However, the ultimate test is to find out what the micro is registering. Programs A and B sample the input 1000 times in quick succession and count the number of timest that a 'high' (or '1') is recorded. Run the program and then examine the register (0F1F in Mk-14, 0051 in Acorn) to find the score. An average figure of 50 (32 Hex) should be obtained over 10 or more runs.

Programs C and D take a single sample, producing '0' or '1' in the ac-

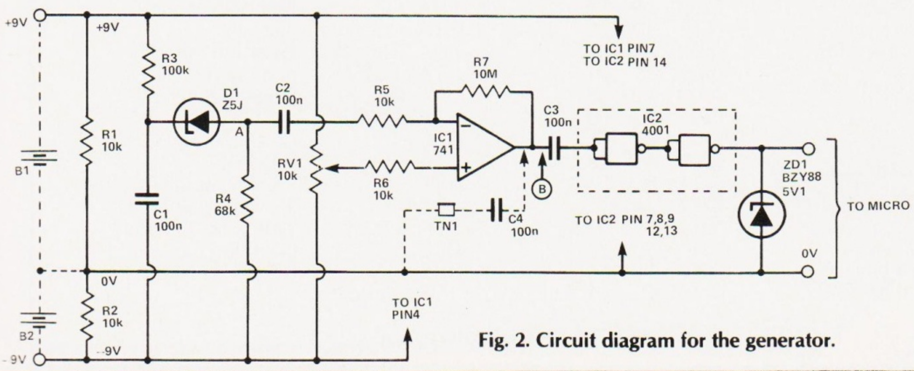

Fig. 2. Circuit diagram for the generator.

cumulator N flag. This is the equivalent of tossing the penny and can be used at any stage in a program when a random 'either/or' choice is required. Once we can obtain random '0's and '1's, our way is clear to producing random numbers. To get an eight-bit number we simply sample the output of the generator eight times, once for each digit required. Programs E and F perform this function, rotating the accumulating digits to fill the eight bits in turn. The result is a random number in the range 0-255. If you wish for a smaller range, alter the program to reduce the numbers of digits or reject any numbers that fall outside your required range.

Random Dice

If your games program requires the equivalent of 'throwing a six', for example, you can run program A or B and adjust RV1 until you get 'high' on an average of one sampling in six. It is better to take 120 samples, change 0F25 of Program A to 79H (121 decimal) and look for 14H (20 decimal) higher. In Program B change 020A to 78. You can set RV1 to produce '1's with any probability level from 0 (never) to 1 (always). It would be practicable to use a potentiometer with pointer knob and a scale graduated for a range of probabilities. Then you could set it to 'tossing a coin', 'throwing a six', 'drawing an ace' or even 'winning the Treble Chance', as required.

Parts List

Resistors (all ¼W, 5%)
R1,2 10k (not required when using batteries)
R3 100k
R4 68k
R5,6 10k
R7 10M
RV1 10k horizontal preset

Capacitors
C1,2,3 100nF disc ceramic

Semiconductors
IC1 741
IC2 4001
D1 Z5J noise diode
ZD1 5V1 BZY88

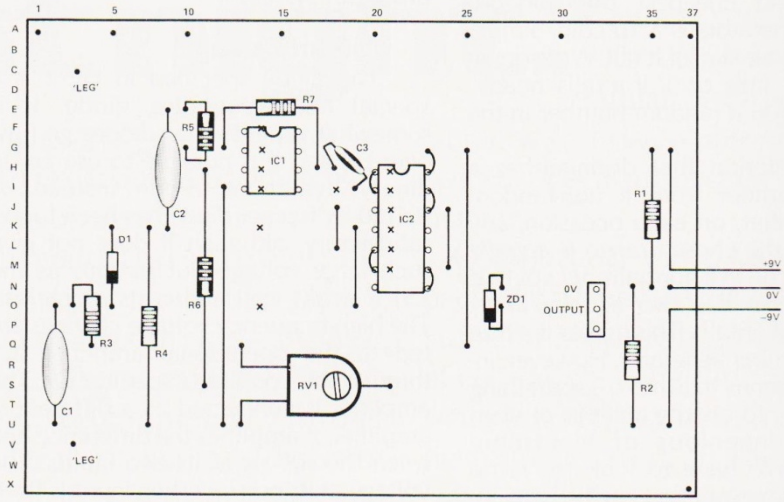

Fig. 4. The Veroboard layout for the generator.

Program Listing

```
0F20  C4  00         LDI '00'      Clear the '1's
0F22  C8  FC         ST at 0F1F    counter
0F24  C4  65         LDI '65'      Set sample counter to
0F26  C8  F7         ST at 0F1E    number of samples + 1
                                   (101)
0F28  B8  F5      A: DLD 0F1E      Counting down
0F2A  98  09         JZ to B       When finished
0F2C  6C             CSA           Read SENSE A input
0F2D  D4  10         ANI '10'      Pick out bit
0F2F  98  F7         JZ to A       If this bit is '0'
0F31  A8  ED         ILD 0F1F      Counting '1's
0F33  90  F3         JMP to A      For next sample
0F35  3F          B: XPPC          Return to monitor
```

Program A Setting up program for the Mk-14.

```
0200  A9  FE         LDA 'FE'          Make B0 an input
0202  8D  23  09     STA at 0DB
0205  A9  00         LDA '00'          Clear '1's counter
0207  85  51         STA at 0051
0209  A9  64         LDA '64'          Set sample counter
020B  85  50         STA at 00500      to 100
020D  C6  50      A: DEC               Counting down
020F  30  0A         BMI to B          If N = 1 (finished)
0211  2C  08  09     BIT               Read B0
0214  10  F7         BPL to A          IF N = 0 (sample = 0)
0216  E6  51         INC               Counting '1's
0218  4C  0D  02     JMP to A
021B  4C  04  FF  B: JMP to monitor
```

Program B As Program A but for the Acorn.

```
0F50  06             CSA           Read SENSE A input
0F51  D4  10         ANI '10'      Pick out bit
0F54  9C  08         JNZ to A      If bit is '1'
0F56 to 0F5D                       Subroutine if bit is '0'
0F5F onwards      A:               Subroutine if bit is '1'
```

Program C The 'heads or tails' subroutine for Mk-14s.

```
0250  2C  08  09     BIT           Read B0
0253  30  08         BMI to A      If bit is '1'
0255 to 025C                       Subroutine if bit is '0'
025D onwards      A:               Subroutine if bit is '1'
```

Program D As Program C but for the Acorn. Note that B0 has already been defined as an input in Program B.

```
0F20  C4  00         LDI '00'      Clear random number
                                   register
0F22  C8  FC         ST at 0F1F
0F24  C4  08         LDI '08'      8 bits required
0F26  C8  F7         ST at 0F1E
0F28  06          A: CSA           Read SENSE A input
0F29  D4  10         ANI '10'      Pick out bit selected
0F2B  F0  F3         ADD 0F1F      Previously selected bits
0F2D  1E             RR            Move bits one to right
0F2E  C8  F0         ST at 0F1F    With new bit added
0F30  B8  ED         DLD 0F1E      Counting bits
0F32  9C  F4         JNZ to A      For next bit
0F34  3F             XPPC          Return to monitor
```

Program E Generating an eight-bit random number on the Mk-14.

```
0200  A9  FE         LDA 'FE'          Make B0 an input
0202  8D  23  09     STA at 0D'
0205  A9  00         LDA '00'          Clear the random
0207  85  51         STA at 0051       number register
0209  A9  08         LDA '08'          8 bits required
020B  85  50         STA at 0050
020D  18             CLC               Clear carry bit
020E  AD  08  09  A: LDA               Read B0
0211  65  51         ADC               Previously selected bits
0213  2A             ROLA              Move bits one to left
0214  85  51         STA at 0051       With new bit added
0216  C6  50         DEC               Counting bits
0218  D0  F4         BNE to A          If Z = 0 for next bit
021A  4C  04  FF     JMP to monitor
```

Program F As Program E for the Acorn.

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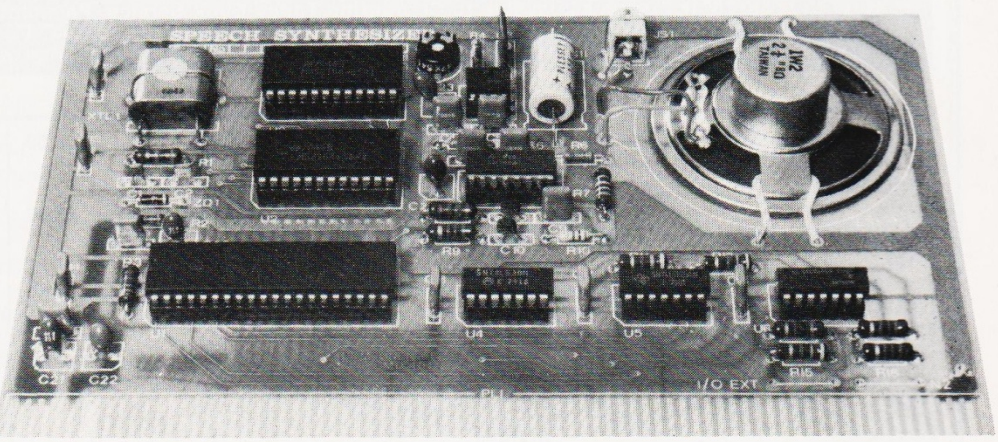
Paul Kriwaczek

The Digitalker speech synthesis system is now available as a plug-in board - we present a user's view

They could have asked Brando or Redford, or, come to that, Jane Fonda or Liza Minelli. But they didn't. So the voice forever trapped in silicon like a fly in amber, encapsulated in two chips called SSR1 and SSR2, is that of an anonymous executive from the PR department somewhere in California. And it sounds like it.

In fact, the National Semiconductor Digitalker System — implemented for NASCOM, Apple and other micros by Arfon Microelectronics Ltd — shows very clearly some of the advantages and disadvantages of this particular way of synthesising the human voice.



I won't go into great detail over the principles of voice synthesis, already described so clearly by Henry Budgett in July's issue of CT. In brief, the Digitalker system consists of a speech processor chip which contains the noise-making and control circuitry, in this case feeding an on-board amplifier and speaker, and two speech ROMs which store all the necessary information to make the resulting noise meaningful.

Dramatic Techniques?

The result of this approach to voice synthesis is that, unlike other systems, you get complete words, properly pronounced. Or, almost! In a technique which depends among other things on eliminating redundancy in the speech waveform, one is very much at the mercy of what the electronics engineer regards as redundant. Alas, it seems that this category can sometimes include those features of a word which actually make it intelligible.

In normal human speech, things aren't so critical since we normally hear words surrounded by other words, and if we miss one, we can usually hazard a good guess as to what it was from its context in the sentence. And we very quickly adjust our mental decoding apparatus to allow for such things as accents and dialects. It doesn't usually take more than few mintues to grow accustomed to even the thickest Hebridean porage accent or Yugoslav immigranto. With the AML speech board, however, we are unlikely to have the opportunity to listen to lengthy harangues, so it can take some time to get used to its rather peculiar habits of pronunciation and emphasis.

It is of course in the nature of a system which depends on calling up words from a stored vocabulary that each word in a possible sentence is given the same emphasis. But I would have thought it might occur to somebody somewhere along the line that such heavy stress on the first syllable of nearly every word was inappropriate. Particularly a word like 'and' which is most unlikely ever to need such strong emphasis. The consequence of this is that given a string of words to speak, the system responds like a five-year-old reading from a story book. Every word is there, but not a trace of understanding.

And this is no minor quibble. ICL's research department have been interested in voice output for some time, with the aim of making telephone communication with computers easier. One of the most interesting results of the work is to confirm that if the machine's intonation and emphasis are not the way a person would speak, it makes it difficult for a human to use the information given by the computer; even to remember a string of numbers for long enough to write them down. Not too far, in fact, from Hamlet's advice to the players:

> 'Speak the speech, I pray you, as I pronounced it to you trippingly on the tongue: but if you mouth it, as many of your players do, I had as lief the town-crier spoke my lines.'

And the town crier is exactly what Digitalker does sound like, when putting a sentence together from individual words.

But one of the benefits of this method of speech generation is that it is not restricted to single words or worse, to single phonemes. So Digitalker allows whole phrases or sentences to be encoded without taking up unreasonable amounts of memory, and then of course the appropriate intonation and emphasis can be ensured.

This is ideal for the equipment manufacturer or the industrial user but National are not giving away any of their trade secrets. 'Encoding' they insist in the application notes, '. . . must be done by National Semiconductor. Customers submit to the factory high quality recorded magnetic reel to reel tapes containing the words or phrases to be encoded.'

In the meantime, available for general use is a ROM pair with numbers, letters of the alphabet, units of measurement and a few other useful words like 'Danger', 'Error' and 'Please'. AML are in the process of having their own ROMs made by National, presumably with an English accent this time, but even using the standard set they have been very imaginative in their use of what might at first examination seem a rather limited resource.

Putting It To Use

For NASCOM and Apple, where the speech card can be plugged straight onto the bus, use of the board could not be simpler. Each word in the vocabulary is associated with a code byte. Send that byte to the port which the card decodes as its address, and the unit speaks. To wait until the word is finished, just keep testing bit 0 of the same port and when it goes low, Digitalker is ready to speak again.

But to speak what? That is the ques-

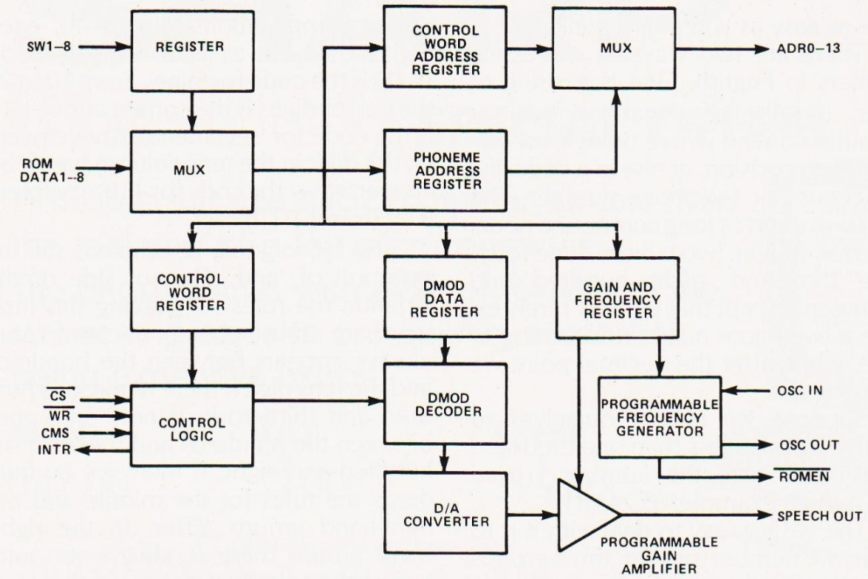


Fig. 1. Above is the block diagram of the SPC. The waveform diagrams top right show the stages in the reduction of the speech information: a) shows the original speech, b) the signal after it has had its phase angle adjusted and c) the final stage before digitization. Pin-out of the SPC is shown on the right.

Word	Keyboard Address	8-Bit Binary Address SW 8 → SW 1
THIS IS DIGITALKER	000	00000000
ONE	001	00000001
TWO	002	00000010
THREE	003	00000011
FOUR	004	00000100
FIVE	005	00000101
SIX	006	00000110
SEVEN	007	00000111
EIGHT	008	00001000
NINE	009	00001001
TEN	010	00001010
ELEVEN	011	00001011
TWELVE	012	00001100
THIRTEEN	013	00u01101
FOURTEEN	014	00001110
FIFTEEN	015	00001111
SIXTEEN	016	00010000
SEVENTEEN	017	00010001
EIGHTEEN	018	00010010
NINETEEN	019	00010011
TWENTY	020	00010100
THIRTY	021	00010101
FORTY	022	00010110
FIFTY	023	00010111
SIXTY	024	00011000
SEVENTY	025	00011001
EIGHTY	026	00011010
NINETY	027	00011011
HUNDRED	028	00011100
THOUSAND	029	00011101
MILLION	030	00011110
ZERO	031	00011111
A	032	00100000
B	033	00100001
C	034	00100010
D	035	00100011
E	036	00100100
F	037	00100101
G	038	00100110
H	039	00100111
I	040	00101000
J	041	00101001
K	042	00101010
L	043	00101011
M	044	00101100
N	045	00101101
O	046	00101110
P	047	00101111
Q	048	00110000
R	049	00110001
S	050	00110010
T	051	00110011
U	052	00110100
V	053	00110101
W	054	00110110
X	055	00110111
Y	056	00111000
Z	057	00111001
AGAIN	058	00111010
AMPERE	059	00111011
AND	060	00111100
AT	061	00111101
CANCEL	062	00111110
CASE	063	00111111
CENT	064	01000000
400HERTZ TONE	065	01000001
80HERTZ TONE	066	01000010
20MS SILENCE	067	01000011
40MS SILENCE	068	01000100
80MS SILENCE	069	01000101
160MS SILENCE	070	01000110
320MS SILENCE	071	01000111
CENTI	072	01001000
CHECK	073	01001001
COMMA	074	01001010
CONTROL	075	01001011
DANGER	076	01001100
DEGREE	077	01001101
DOLLAR	078	01001110
DOWN	079	01001111
EQUAL	080	01010000
ERROR	081	01010001
FEET	082	01010010
FLOW	083	01010011
FUEL	084	01010100
GALLON	085	01010101
GO	086	01010110
GRAM	087	01010111
GREAT	088	01011000
GREATER	089	01011001
HAVE	090	01011010
HIGH	091	01011011
HIGHER	092	01011100
HOUR	093	01011101
IN	094	01011110
INCHES	095	01011111
IS	096	01100000
IT	097	01100001
KILO	098	01100010
LEFT	099	01100011
LESS	100	01100100
LESSER	101	01100101
LIMIT	102	01100110
LOW	103	01100111
LOWER	104	01101000
MARK	105	01101001
METER	106	01101010
MILE	107	01101011
MILLI	108	01101100
MINUS	109	01101101
MINUTE	110	01101110
NEAR	111	01101111
NUMBER	112	01110000
OF	113	01110001
OFF	114	01110010
ON	115	01110011
OUT	116	01110100
OVER	117	01110101
PARENTHESIS	118	01110110
PERCENT	119	01110111
PLEASE	120	01111000
PLUS	121	01111001
POINT	122	01111010
POUND	123	01111011
PULSES	124	01111100
RATE	125	01111101
RE	126	01111110
READY	127	01111111
RIGHT	128	10000000
SS	129	10000001
SECOND	130	10000010
SET	131	10000011
SPACE	132	10000100
SPEED	133	10000101
STAR	134	10000110
START	135	10000111
STOP	136	10001000
THAN	137	10001001
THE	138	10001010
TIME	139	10001011
TRY	140	10001100
UP	141	10001101
VOLT	142	10001110
WEIGHT	143	10001111

Table 1. The 144 words in the standard vocabluary. Just dial the address and out they come! Code 129, 'SS', makes anything else plural.

tion. I can imagine numerous control applications where voice output could be of benefit. In an industrial setting where some complex machine tool requires great concentration to use it, it could become unnecessary for the operator to take his eye off what he is doing. In another situation, where the computer output is not continuously monitored, the voice could draw attention to some non-standard combination of readings. Even the homely gas meter, buried as it usually is under old deckchairs and antique suitcases in the dark of the cupboard under the stairs, would benefit greatly from the power of speech. Just think how much the Gas Board would save on torch batteries.

But for the user of a personal computer the speech board falls into the category of peripherals for which there must be a thousand uses. It's just that I can't quite put my finger on any of them.

If an ability to speak is to be a genuinely useful addition to a micro, it must be able to produce more than just numbers, letters and the limited phrases one can generate by combining the words in the speech ROMs. Ideally, it should be possible to pass words to the voice board for spoken output just as one passes them to a printer for hard copy. The Digitalker system with its set vocabulary doesn't make allowances for this. But that's where AML's imagination comes in.

They suggest that by interrupting a word early and starting another, one can use the current word list as a kind of phonetic resource, mining it for the sound to build up words which don't appear in the vocabulary. 'COMPUTING', for example, could be built from the CO in the 'CONTROL', the M of 'MARK', the P of 'PULSES', the letter 'U', the T of 'TIME' and an approximation to the 'ING' from the word 'IN'.

The AML documentation includes software both in machine code and BASIC to set up and manipulate a speech file: a string of bytes, which when sent to the speech board will cause the required words to be spoken. The BASIC program in particular is a neatly sophisticated item, but it cannot overcome two major impediments. First, as can be seen from the example 'COMPUTING', we are limited to using only the beginnings of words. Digitalker can be interrupted while speaking but there seems to be no way of starting it up in the middle of a word. So if there is no word starting with the sound we are looking for we are forced to take second best — IN instead of ING.

There is also another problem. This way of building up words is based on the phoneme as a unit of speech. But the phoneme is defined as the minimum sound feature of a language which is perceived as different from all others; and just because the difference is not perceived does not mean that it is not there. The 'k' sounds in the word 'cough' and 'kiss' may seem the same to us but they are actually quite different. Languages like Arabic represent them by two different letters. And we all know the difficulty Japanese speakers have in distinguishing 'l' and 'r'. To the Japanese ear, they are the same sound.

But while we may not be consciously aware of these differences, put the ALLOPHONES, as they are called, consistently in the wrong place and the speech becomes increasingly difficult to understand. If you then add the impossibility of controlling emphasis, stress and intonation when constructing words out of separate building blocks, as well as the broken effect the sounds give when they don't flow smoothly into each other, you may end up with a computer which speaks, but of which the casual listener can make little sense. Of which one might say, as Dr Johnson said of a woman preaching, that it is '. . . like a dog walking upon its hinder legs. It is not done well but you are surprised to find it done at all.'

A Softer Conclusion

I suppose I may be a little hard on the Digitalker system because my business, which is broadcasting, makes me extremely conscious of the quality of the spoken word. So I really should say that there is one use for voice output on a home computer which the AML speech card suits perfectly, and that is in games. A voice which speaks the score is an attractive addition to any game, particularly where it's not advisable to take your eye off the field of play even for a moment.

And working out how to convert a number into a string of speech codes makes an interesting exercise. It's not quite as easy as you might think.

There are two ways of expressing numbers in English. One is a string of digits, usually in a mathematical or scientific context where there is an emphasis on precision, or else in a code like an account or telephone number. The other is as a sort of long compound noun: sixty-five million, two hundred and forty-three thousand, eight hundred and seventeen. Except that we very rarely express a two-figure number as a string of digits, while after the decimal point we always do.

Suppose we restrict ourselves to positive integers less than one thousand million and take the number I used above as an example: 65,243,817.

The easiest way to deal with it is to divide the number into the three groups marked off by the commas: into millions, thousands and units. Then send each group to a subroutine for conversion into speech code. After the leftmost group send the code for 'MILLION', after the middle group the code for 'THOUSAND' and after the right-hand group add nothing at all. The actual conversion of each group can be done by taking each digit of the string starting from the left, one digit at a time, and converting it into the appropriate speech code. This would be very simple if it were not for a few minor complications. Up to 10, each digit is the same as its own speech code — 09 is the code for 'nine'. From 10 to 20 the pair of digits is the correct code — 17 is the code for 'seventeen'. Above twenty, the digit in the tens column has to be converted — the code for 43 (forty-three) is 22 (forty), 03 (three).

So far so good. But there is still the question of 'and'. On our side of the Atlantic the rules for placing this little word are amusingly complicated. 'And' always appears between the hundreds and the tens digit if there is one: one hundred *and* thirty-four. If not, 'and' goes between the hundreds and the units: six hundred *and* eight. If there are no hundreds the rules for the middle and the right-hand groups differ. In the right-hand group, there is always an 'and' before the units digit, as long as there has been some number in the millions or thousands group: four thousand *and* two. In the middle group, no 'and' appears if there are no hundreds or tens: one million, three thousand *and* twenty-six. All this means that to get it right there has to be a nifty bit of flag setting and resetting.

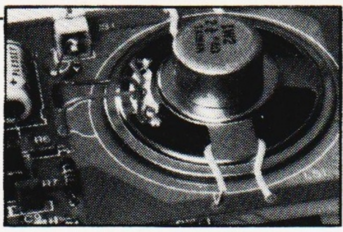
Here's my version in a standard Microsoft BASIC. I leave it to you to add the figures after the decimal point.

Program Listing

```
10010  REM**ENTER ROUTINE WITH NUMBER IN N
10020  AF=0:REM**AF IS THE AND FLAG
10030  M1=INT(N/1000000):REM**MILLIONS
10040  A1$=STR$(M1):REM**MILLIONS STRING
10050  A1$=RIGHT$(A1$,LEN(A1$)-1):
       REM**STRIP LEADING SPACE
10060  M2=INT((N-(M1*1000000))/1000):
       REM**THOUSANDS GROUP
10070  A2$=STR$(M2):REM**THOUSANDS STRING
10080  A2$=RIGHT$(A2$,LEN(A2$)-1):
       REM**STRIP LEADING SPACE
10090  M3=INT((N-(M1*1000000))-(M2*1000)):
       REM**UNITS GROUP
10100  A3$=STR$(M3):REM**UNITS STRING
10110  A3$=RIGHT$(A3$,LEN(A3$)-1):
       REM**STRIP LEADING SPACE
10120  B$=A1$:REM**MILLIONS GROUP
10130  IF VAL(B$)=0 THEN GOTO 10170
10140  AF=1:REM**SET AND FLAG
10150  ON LEN(B$) GOSUB 10390,10310,10270
10160  Z=30:GOSUB 10430:REM**'30' IS THE
       CODE FOR 'MILLION'
10170  B$=A2$:REM**THOUSANDS GROUP
10180  IF VAL(B$)=0 THEN GOTO 10220
10190  AF=1:REM**SET AND FLAG
10200  ON LEN(B$) GOSUB 10390,10310,10270
10210  Z=29:GOSUB 10430:REM**'29' IS THE
       CODE FOR 'THOUSAND'
10220  B$=A3$:REM**UNITS GROUP
10230  AF=0:REM**RESET AND FLAG
10240  IF VAL(B$)=0 THEN GOTO 10260
10250  ON LEN(B$) GOSUB 10390,10310,10270
10260  END
10268  REM**NUMBER GROUP SUBROUTINE
10269  REM**Z IS THE CODE TO SEND TO THE
       SPEAK SUBROUTINE (10430)
10270  Z=VAL(LEFT$(B$,1)):GOSUB 10430
10280  Z=28:GOSUB 10430:REM**'28' IS THE
       CODE FOR 'HUNDRED'
10290  B$=RIGHT$(B$,2))
10300  IF VAL(B$)<>0 THEN Z=60:GOSUB 10430:
       AF=1:REM**'60' IS THE CODE FOR 'AND'
10310  IF VAL(LEFT$(B$,1))=0 THEN GOTO 10390
10320  IF AF=0 AND N>99 THEN Z=60:GOSUB 10430:
       AF=1
10330  IF VAL(B$)>20 THEN GOTO 10360
10340  Z=VAL(B$):GOSUB 10430
10350  GOTO 10410
10360  IF VAL(LEFT$(B$,1))=0 THEN GOTO 10380
10370  Z=VAL(LEFT$(B$,1))+18:GOSUB 10430
10380  B$=RIGHT$(B$,1)
10390  IF VAL(B$)=0 THEN GOTO 10420
10400  IF AF=0 AND N>99 THEN Z=60:GOSUB 10430
10410  Z=VAL(B$):GOSUB 10430
10420  RETURN
10429  REM**SPEAK SUBROUTINE
10430  WAIT 246,1
10440  OUT 246,Z
10450  RETURN
```

The program listing to make the AML Speech Board utter its numbers in 'proper' English. Not only does it do its job but it is also a good example of string manipulation!

THE AM SPEECH BOARD



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The on-board power amplifier and 2½" speaker will give you immediate speech from your software instructions. The instructions are simple and demand no extensive re-write or patching, in fact, speech is as easy as display.

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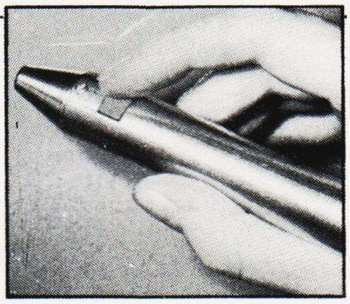
& AM LIGHT PEN



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Command Level:

1. Display any sector.
2. Automatically load the Directory track.
3. Enter a DOS command, execute and return.
4. Recall the Buffer.
5. Display the disk statistics of a file.
6. Go direct and display a file by sector.
7. Copy a disk.
8. Go to Debug and return to Prozap.
9. Disable the disk system usage.
10. Encipher a Password.
11. Read any track into memory so that the contents of it may be examined, including the sector layout and other data.

Display Level:

1. Hexadecimal or ASCII modify mode.
2. Page to previous or next sector.
3. Jump to a specified byte.
4. Display same track and sector, different drive.
5. Output a sector.
6. Zero all or part of a sector.
7. As above but with any non zero byte.
8. Search for a byte or search for a word.
9. Display Hash Code and its correct position.
10. Go direct into file display mode.
11. Print a sector on the line printer.
12. Page to a new track or sector.
13. Save a sector to memory.
14. Load buffer from memory.
15. Match the current sector with another.

Display is in hex and ASCII with a linking cursor for ease of use. Written by Nigel Dibben and in our opinion by far the best program of its kind on the market. Supplied on disk.

*ZAP — a colloquialism (American) meaning a computer program which has the ability to access magnetic storage disks for investigation or modification. Derivation unknown.

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ALPHATRONIC REVIEWED

Ron Keeley

It's got the look of a serious machine, it feels like a serious machine, but what actually lurks under that stylish exterior? Read on and all will be revealed

According to their publicity, Adler are the '. . first company in the micro market to have a business computer pedigree', and the Alphatronic is not merely '. . . a hobby computer that happens to have found itself in the business market'.

The Alphatronic, '. . . with its simplicity of use . . . is tailored for users not educated in the jargonistic (sic) world of computer technology' and combines '. . . the breadth of requirement and durability of a business machine and the ease of use of a personal computer'.

With these and other encouraging words in mind, I set out to look at the Alphatronic from the point of view of a first-time non-technical user.

Unfortunately, it must be said that the Alphatronic fails to live up to many of the claims made for it. Specifically, it is not at all easy to use. In part, this is due to a number of minor, frustrating faults but derives mostly from a design philosophy descended directly from Adler's experience with mainframe business systems. In fairness, however, a new version of Microsoft Extended BASIC for the Alphatronic, released in August but not available at the time the system was reviewed, will go some distance towards restoring something of the '. . . ease of use of a personal computer'.

The Physical Machine

First impressions were promising; the Alphatronic looks good, with none of the blocky, stacked-box appearance of some other discrete component systems. The 'microframe' is a durable white and brown plastic case, compact and slim and of a size to fit comfortably on even the smallest desk. The power switch is situated low on the left rear corner and the I/O connections in a deep recess in the rear panel. The twin disc drives are horizontally mounted but (the first niggle . . .) the mechanisms that hold the discs are not spring loaded — ie discs do not spring out when the gates are opened. However, one soon becomes accustomed to reaching into the drives with the index and third fingers — no way can you comfortably get a thumb in there — and to promptly removing discs from open drives; failure to do this results in frustrated attempts to fit two discs into a space designed for one . . .

The keyboard (see Fig. 1.) has several unusual features: the location and unusually small size of the Input (Return) key is annoying at first but using it soon becomes second nature. More disconcerting is the three-key level shift. The 'SM' key operates as a shift-lock for letters only and is, apparently, programmable although no hint of how to use it is given in any of the documentation. On loading BASIC, for example, the display comes up with letters in upper case but numbers and non-alphabetic characters are unshifted so that the two 'sections' of the keyboard are effectively out of sync. Lower case letters and punctuation characters (quotes etc) are produced by what one normally thinks of as an upper-

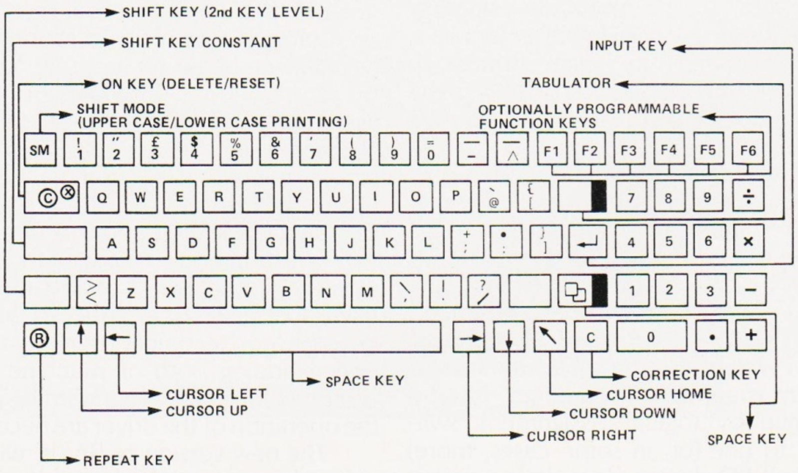


Fig. 1. The Alphatronic's keyboard layout. The unmarked keys are not us being lazy, they really are unmarked!

case shift. It's handy when entering a program, but takes some getting used to. Some other 'different' features include the shift-unlock, which is achieved by toggling the shift-lock key rather than the shift/unshift key, and the layout of the cursor control keys, which are split either side of the space bar.

Most disconcerting, however, is the single-stroke reset key, situated just above the shift-lock on the left of the keyboard. Fortunately it is not a Master Reset; although control is returned to the operating system, memory is not cleared and a program can be re-started by entering 'G'. This loads the program counter with the value 4010 Hex and effects a jump to that location. Since BASIC (and CP/M, apparently) are loaded from 4010H, accidentally RESETing causes no problems; however, at least one of the applications software packages supplied for review purposes would not re-start and any work in hand not saved on disc was lost and gone forever.

The remaining piece of Alphatronic hardware is the VDU, a neat 12" industrial monitor with an uncluttered 'naked screen' appearance. It sits easily on the 'microframe' and exhibited no sign of instability at any time. It is, incidentally, made in Japan.

According to the specifications, the monitor displays 24 lines of 80 characters; how it goes about managing this display is another story altogether. A block diagram of the hardware is shown in Fig. 2.

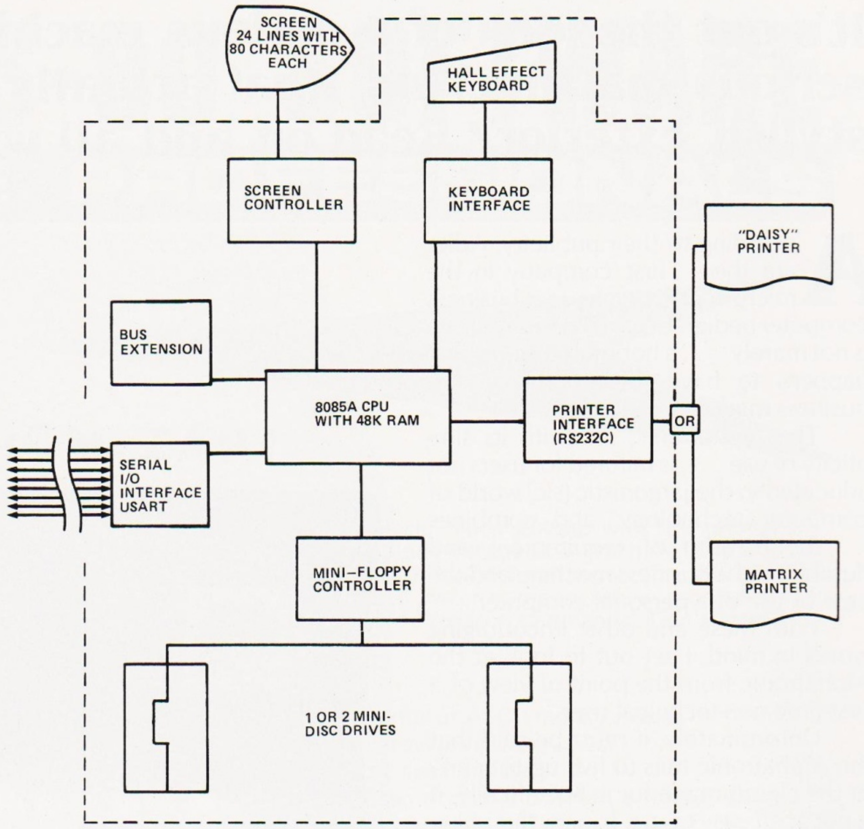


Fig. 2. This is the system's block diagram. Plenty of expansion capability and enough inside to be going on with.

The Logical Machine

The memory map (Fig. 3) shows how the 48K are used. The bottom 7K are taken up by MOS (the Microcomputer Operating System) and its stack. Passing over it for the moment, the next significant area of memory is the 4K allotted to the display. This space is not related to the screen area: it is not memory-mapped, as attempts to define the screen memory locations soon demonstrate. Instead, the Alphatronic appears to use a one-line screen buffer (which is user accessible) from which information is passed, by the operating system, to the screen. The screen itself is not user accessible.

This method of handling the display is a consequence of the logical/physical device management system built into the MOS.

The I/O System (IOS) defines five logical I/O streams (Reader, Command Input, Command Output, Writer and Lister) which are controlled by special Stream routines. Each Stream may be assigned by logical Assignment Switches, to one (or, in some cases, more) physical I/O device via a device driver. No doubt this is an effective method of I/O management, but by including the display in this system the Alphatronic's designers have gone right back to the Dark Ages of microcomputer systems (all of five years ago).

By choosing *not* to use a memory-mapped display they have missed out entirely on what is probably the most important feature of microcomputers, in terms of attractiveness to users: memory-mapping allows '. . . users not educated . .' to easily write 'clever' programs. Animated graphics and games, drawing forms and graphs or formatting data on the screen — all these things are relatively easy to do with a memory-mapped display system. They can be done on the Alphatronic, but it isn't easy.

Various screen driver routines can be called and used, for example, to move the cursor about (although no call is listed for CURSOR UP) or to write characters at a given location on the screen. Many of the system calls can be made from BASIC, but others require a section of machine code to pass data and/or multiple parameters to the driver. The procedures are complicated and likely to cause some difficulty to your average 'non-technical user', as a good understanding both of machine code/assembly language programming and of the operation of the driver are necessary.

The new version of BASIC will provide at least a partial solution; it will support direct cursor addressing and SET/RESET of individual pixel elements. It is not known if it will support some equivalent of the TRS BASIC command, PRINT AT . . ., which would introduce another level of control and allow use of the composite pixel characters which lurk, unrecognised and unmentioned, in the character generator. Perhaps it will also support the six programmable function keys; I have been unable to find any reference to them beyond the statement that they are supposed to be programmable.

Returning to the MOS, it can be seen that the Command System (see Table 1) includes much more than the usual system monitor commands — though by some oversight there is no instruction

.A	Assignment of I/O stream and driver/device
.L	List command output on/off
.M	Move memory
.D	Display memory
.P	Set device parameters
.I	Input file
.E	Close file (Endfile)
.S	Change memory contents
.G	Jump to specified address (Execute)
.O	Output file
.F	Fill memory area with constant
.C	Compare memory areas
.B	Batch mode
.U	Start user program
.T	Set top of memory
.X	Extend MOS software

Table 1. The MOS operating system command set.

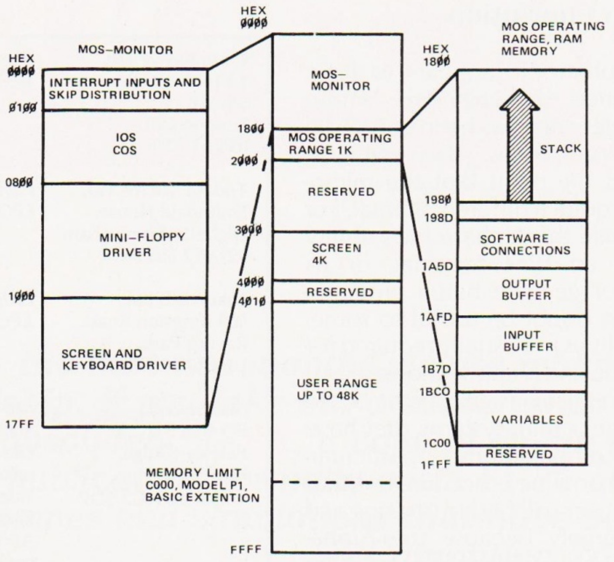


Fig. 3. Where the memory goes and what it's used for.

for examining or changing the contents of the 8085 registers. COS is described as '. . . a simple job control language' — a term more frequently used in the context of mainframe systems! Together with the device drivers — keyboard, printer, disc and, unfortunately, screen — MOS would be a powerful programming tool for experienced software engineers. Inexperienced programmers need not apply.

Languages

Included in the price of an Alphatronic are a CP/M 2.2 disc and a Microsoft Extended BASIC. A Macro-80 Assembler and a Text Editor are also available while a BASIC compiler, FORTRAN compiler and Pascal are under development.

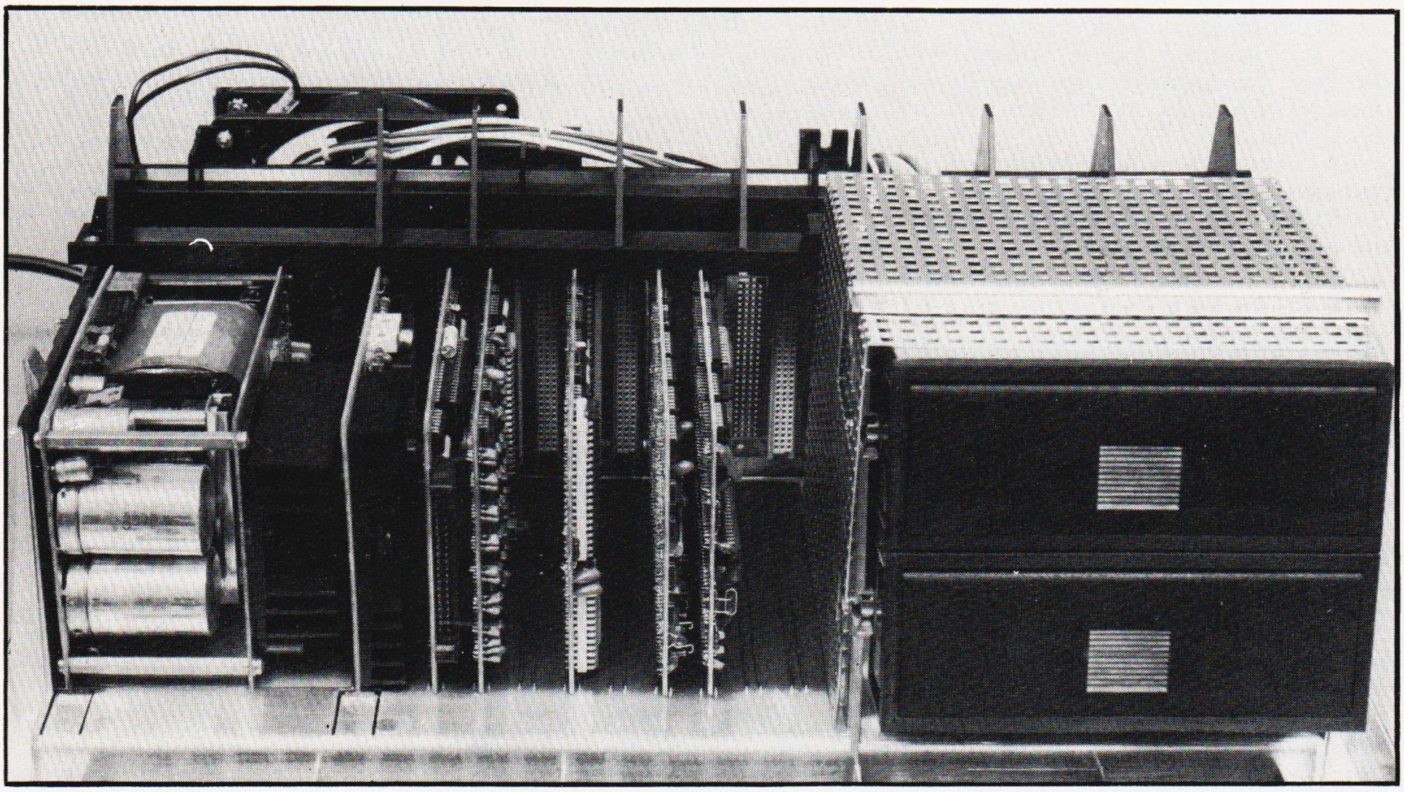
The virtues or otherwise of CP/M are a contentious issue, to say the least; to say the least, I'm not a fan. On the other hand, Microsoft BASIC just keeps getting better. This version has several new and extremely useful functions I'd not encountered before, such as DSKI$, DSKO$ which allow reading or writing directly to or from a specified drive, track and sector. Full error trapping facilities are included although the list of numbered errors is rather short.

There were some curiosities, too. CLEAR always generated one of two error messages, even when using an example from the manual; LOC (File Number) and FPOS (File Number) appeared to perform identical functions and using REC (as in RECord number) as a variable name generated a Syntax Error, indicating that it possibly is a reserved word although it is not mentioned in the manual. And surely the logical antonym of MOUNT is DISMOUNT? Why, then, REMOVE?

Documentation

A set of rather brief operating instructions, a BASIC manual and a CP/M manual are included with the Alphatronic. The System Handbook, describing the MOS and I/O device drivers, is not generally available to non-professionals.

As usual, the standard of documentation is somewhere between inadequate and hopeless. Adler have once again demonstrated that technical



The internal card-frame showing the room left for system expansion and the generous use of shielding against magnetic fields. The fan is a welcome inclusion.

manuals should not, nay NEVER, be written by the people who design the equipment. Engineers are not writers, isn't it obvious?

The System Handbook is particularly chronic, partly because it has been hastily translated from the German original. It contains some appalling errors, as well as the more usual, simply obscure remarks. For example, a paragraph describing how parameters are passed to the screen driver contains this cryptic comment: 'The driver must be the respective number of times'. Eventually the pfennig dropped and the sentence became something like this: the driver must be called each time a parameter is passed. Far worse was the sample machine code routine for reading information directly from a disc. Attempts to run this program — entered character for character off the printed page — kept returning a Syntax Error in Line 350. Spot the error — no prize for any place.

```
350 READ = BF00: FBYT = BF7F: BUFFER
    = BF80
```

Software

Two utility routines are provided on the MBASIC disc. FOKO, used to format new discs, is viciously user-unfriendly. Specifically, it will not warn if the disc being formatted has already been in use and as a result valuable files can be lost — possibly forever, if a back-up hasn't been made. The second routine, 'ALLOC', sets up the soft-sector file directory; it appears to be harmless. A general purpose data base management system running under MBASIC is also supplied free with the Alphatronic.

A considerable number of software packages, covering most small business applications, are already available and the list is growing, see Table 2.

And In Conclusion. . .

The Alphatronic appears to have been designed by engineers whose previous experience has been entirely in mainframe equipment. They seem to have missed the point that the microcomputer is quite a different animal. For example, while the Alphatronic's ability to emulate an IBM terminal, or its capability for genuine batch programming, will no doubt be useful to some, they are facilities not usually required for most small business applications.

By adopting a design scheme based on mainframe or mini-systems, they have introduced complications — particularly in screen handling procedures — that the average user will find frustrating and annoying, largely because the Alphatronic is not compatible with most other microcomputers.

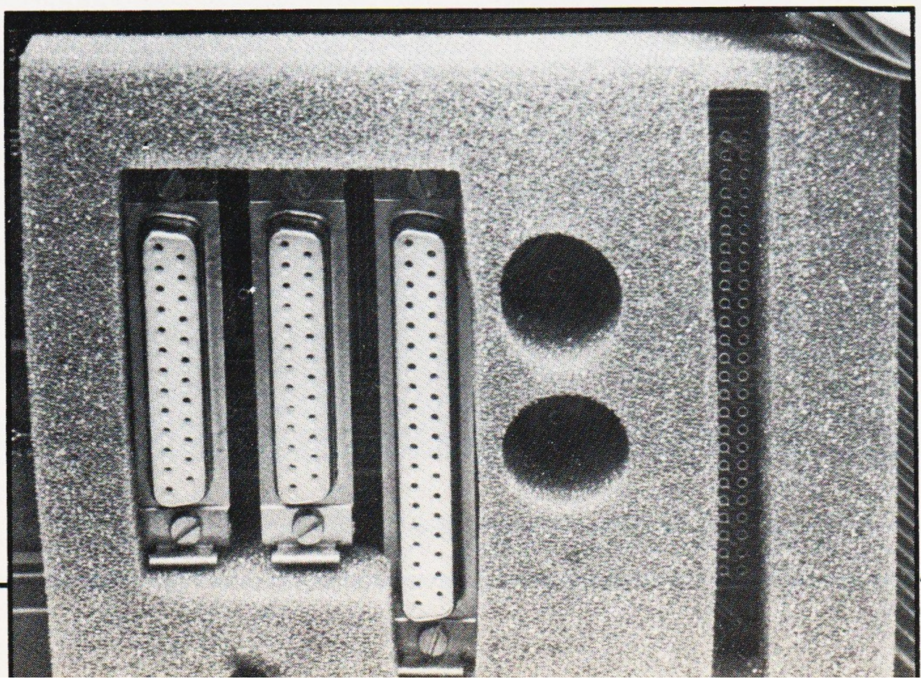
What this means, in the end, is that Mr Average, unless prepared to spend a considerable amount of time sorting out the screen driver routines, will be unable to adapt programs written for a PET, say, to his Alphatronic. He will be effectively cut off from the large number of useful or just plain interesting programs published in Computing Today, and will be completely dependent on commercial software packages.

The effectiveness of the Alphatronic, then, will depend not so much on the machine itself as on the quality of the software. Unfortunately the indications are that one of the utility programs and at least some of the available software are, like the machine itself, not terribly well thought out.

It's not often that a microcomputer can be assessed in one word, but there is just one expression which fits the Alphatronic.

Fragile. Handle with care.

Two serial ports, one bus port and the video output are the socketry supplied.



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Tridata Micros Ltd, Smithfield House, Digbeth, Birmingham 021-622 6085/6	Payroll system £POA
Pakenorth Ltd, 600 Kingston Road, Raynes Park, London SW20 8DN	Ledger system £POA
Microtrend PO Box 51, Pateley Bridge, Harrogate, Yorkshire HG3 5DP	MBASIC: Statistics, File utility & editing, Sales, Financial, Accounting & payroll, Data base, Mailing list, Tutorial, £30-£600 CP/M: Wordprocessor, Communications, Teletype emulator £75-350

Table 2. A reasonable amount of business software is coming onto the market for the system.

CPU	Intel 8085A
Clock	3 MHz
Operating system	6K ROM, 1K RAM
DOS and VOS	9K
User memory	48K
I/O connections	Serial RS232 printer Additional RS232 IEC parallel bus
Keyboard	QWERTY (BS 2481) Hall Effect switches 10-key numeric pad Cursor control keys 6 programmable function keys
Disc Drives	
Capacity	2x5¼", 320K total
Format	Single sided, double density soft sectored
Tracks	40
Sectors per track	16
Bytes per sector	256
Mean access time	140 mS track to track
Transmission rate	125 bits/sec
Dimensions	200x470x500 mm
Weight	14kg
Visual Display	
Screen size	12"
Phosphor colour	green
Character display	24 lines of 80 characters programmable normal or reverse
Weight	7.5 kg
Price	£1,825 excl VAT
Distributed by	Adler Business Systems Ltd, 27 Goswell Road, London EC1M 7AJ 01-250 1717

Table 3. The Alphatronic's vital statistics.

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For the next two months we are making a very special offer to our readership. If you take out a subscription to Computing Today we'll send you, absolutely **FREE***, a copy of Home Computing: Games Programs. This publication normally costs £1.75 and is packed with some of the best games and simulations that have been published in early issues of Computing Today.*

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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.

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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.

Henry Budgett

Our second new feature is dedicated to coping with the questions that arise from using your micro

This section of the magazine will be used as a forum to answer your enquiries in public, and will be a regular feature from now on. It does not replace our Technical Enquiry service, which deals with problems occurring within the magazine, but will hopefully answer those questions that you've always wanted to ask but have felt that you should really know the answer to already, or those that you wouldn't be able to ask anywhere else. Obviously we can't print all the letters we receive in a month so we'll select the most interesting or amusing ones.

If you have a question for us, drop a line to #FILE at our usual address but don't bother to include the usual SAE. We can't promise that you'll get a public answer but we'll do our best.

In The Beginning

Our first enquiry comes from Mr G Deakin of St Johns, Worcester.

Could you please tell me how much expansion in terms of memory and facilities is available for a Video Genie EG3003 without using the expansion box, and is this expansion external or internal?

Oh that all questions were as easily answered! Sorry, Mr Deakin, but if you won't pay the £195 for the basic expansion unit the only extras you can add are a parallel or serial printer and the floppy tape system. The price given for the expander includes a parallel printer port, an S100 bus port and the floppy disc controller; RAM is extra. Lowe Electronics are the people to get in touch with as far as the Genie is concerned and they will be pleased to answer your enquiries.

Making A Meal...

Paul O'Hanlan of Brickhill, Bedford, raised a fairly common problem when he wrote:

I am writing to you to enquire on a number of matters. The first deals with various signs used on many computers but not on my ZX81. The four main signs are '@', '#', 'VDU' and '?'; the Triton is a particular example. I would much appreciate it if you could help me by telling me what statements I could use instead of those listed above.

The second matter concerns the RANDOMISE function used in almost every program today. Although I understand the way it is set out on my computer I am having great difficulty with conversions.

The third problem is the plotting function, I don't seem to be able to put more than one co-ordinate on a line.

My final question concerns the conversion of language used on machines such as the Mk-14 to the language used on my ZX81. Is it possible to convert the two languages and how would I go about it?

A veritable bumper bundle here. The first questions has, unfortunately, a number of answers. The '@' symbol means one of two things. On the Triton it is the variable allocated to the machine's single array, on systems that use PRINT@ it defines the screen location at which printing will start.

Our dear old friend the '#' sign has rather a large number of possible meanings. On the PET it is used to indicate that an I/O file is being PRINTed to or INPUT from, on a very few systems it means 'not equal to'. On systems where the BASIC supports PRINT USING it defines the output format and, finally, it is used on Triton to allocate space for printing numbers on the VDU.

The VDU command, as far as I can tell, is unique to the Triton and is used to control specific functions of that device. For example; any VDU command of the form VDU 0,n performs control functions such as 'Clear Screen', 'Line Feed' or 'Carriage Return'. These are all detailed in our Graphic Details articles. VDU commands of the form VDUn,m act rather like a POKE in that they place character m at location n.

The '?' symbol, where not simply being used in text is almost universally shorthand for PRINT. The one exception that I am familiar with is on the ATOM where it is used as a QUERY function which acts something like PEEK and POKE.

Your next question appears to have got a little muddled. The RANDOMISE function merely resets the seed of the random number generator to a new value thus ensuring a fresh set of random numbers called by RND. The vagaries of the RND function are such that it would probably take most of this feature just to explain them — I'll see what I can do at a later date.

Machine language used on the Mk-14 is that of the SC/MP CPU and, as such, is totally and utterly incompatible with that used by the Z80 CPU in the ZX81! Conversion can be done, by hand, and it takes a thorough working knowledge of both processors to stand much of a chance. Basically it's not worth the effort!

For Free

It is nice to see that some of our readers are moving into the professional side of the computer industry, having learnt their basic skills at home or in college. A typical letter comes from Mr M T Brown of Ongar, Essex, who writes:

I have recently become a Data Control Clerk in a computer department and am interested in learning more about computers and the computer history.

Could you please send me details on the publications you have to offer and their prices. As I am an employee in the computer industry would I be entitled to any free publications?

Well, the only computer publications we produce are the magazine that you've got in your hands and our Home Computing specials but there are a number of freebies that are sent to people in the industry.

The three main weeklies are: *Computing, Datalink* and *Computer Weekly*. The first two are published by VNU Business Publications, 53-55 Frith Street, London W1A 2HG and the other comes from IPC Electrical-Electronic Press, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS. There is a bi-weekly called *ComputerWorld UK* which is published by Thompson Computerworld Ltd, 146-148 Clerkenwell Road, London EC1R 5DJ.

Because these, and the many others, are generally controlled circulation publications, you will have to fill in a form specifying your job function. You are unlikely to qualify for all of them.

The Last Word

Well, that's about it for this month. Don't forget, this feature relies on your enquiries to make it work so if you have something you'd like aired in public drop us a line.

Please keep your usual letters coming in for our PRINTOUT page too — this spot doesn't replace that one in any way.

Mike James

BASIC has more dialects than one can put a name to, but LAB BASIC is rather special

High level languages have, more or less, banished assembly language programming from the home computer market. The exceptions to the rule are those written by enthusiastic systems programmers experimenting with new languages or those demanded because an element of real time control is involved.

Real time control can mean switching signals on your model railway, controlling some production machinery, running a lab experiment or the almost legendary micro application — running your central heating system! It's obvious that with such a wide range of activities real time control is an important area of microprocessor application — when you hear reports of the microprocessor revolution you find that it's control applications that account for most of the innovations. After all, computers have been bookkeeping and sorting pay packets for a long while but are relatively new in washing machines! It is obvious that some way must be found to enable more people to solve control problems, and it is equally obvious that the solution lies in using a high level language. But which one?

Most microcomputers come ready-equipped with BASIC, which is fine if you want to carry out some calculations or print a few messages on a VDU. However, if you want to control some piece of equipment connected to your micro then BASIC, as it stands, has several disadvantages. It is usually too slow to keep up with events in the outside world, it has no standard way of 'talking to' or communicating with external devices, apart from the commands INPUT and PRINT, and it has no standard way of connecting devices to the micro. All these problems make using BASIC just as difficult as using assembly language in control applications. Usually a control program in BASIC is nothing more than a long list of PEEK and POKE statements (see below). It is therefore impossible to read and to understand, and difficult to transfer to another machine, unless that machine is very similar or the programmer has been extremely kind and painstaking.

From all of the above more people conclude that all in all, control programs are best tackled on a micro in assembly language, taking them well out of the reach of the beginner and rendering them completely machine dependent. The problem seems to lie in BASIC. Perhaps we should look at some other high level languages specially designed for control. If we want to find as general a solution as possible to the control problem we should look at an application area that is as varied and as demanding as possible. For example, let us consider the control of scientific experiments.

There are many scientific disciplines in which computers are nothing more than a tool — simply another way of carrying out experiments. Those involved in these disciplines are not necessarily interested in learning enough about computers to master assembly language. They simply want to get on with conducting their experiments and collecting their results. Similarly, for teaching experimental technique to students knowing little about computers, it is preferable to be able to concentrate on the actual experiments and their outcomes rather than on the niceties of computer programming. Given these demands, it becomes essential to develop a high level language to control experiments. And given the range of experiments to be controlled this language should stand a good chance of being easy to use in other situations.

If it is possible, rather than invent a whole new language, it makes more sense to add a few new instructions to an existing language. The best language to try to modify is our old friend BASIC because of the reasons given earlier. This is what was done to produce LAB BASIC.

In 1977 Dr George Kiss of Warwick University Department of Psychology presented a set of new BASIC instructions which have become widely accepted within experimental psychology. These extensions are available from a variety of sources and in a number of implementations. One such implementation is the LAB BASIC interpreter and compiler pair described in this article.

Hardware

The first problem that LAB BASIC tackles is to define the connection between the micro and the outside world through the experiment control port 'ECP' (see Fig. 1). This is a pair of eight-bit ports, one input and one output, and two input interrupt control lines. The I/O lines are TTL compatible. The lines of each of the ports are numbered 1 to 8 and this is how they are referred to in LAB BASIC commands. An important feature of LAB BASIC is that a reference to a line 0 is taken to mean all of the control lines. At any *one* time LAB BASIC can deal with only one ECP although there may be a number in any system which can be used by switching them, under software control, in and out.

In General

LAB BASIC is an integer only BASIC with most of the facilities of full BASIC. For example, it includes FOR loops and IF statements but it can only handle integer (whole number) arithmetic. Integer arithmetic works in the same way as normal arithmetic except for division, where any fractional part of the result is simply forgotten (eg 4/3=1 in integer arithmetic). This restriction to integers would be impossible for BASIC programs intended to carry out a lot of calculations but most control programs require only simple arithmetic and demand the extra speed gained by integer only arithmetic.

LAB BASIC has only the 26 variables A to Z available, although this is enough for most control programs. Other features of LAB BASIC include:

- up to two dimensional arrays with a maximum subscript of 256
- hexadecimal constants
- INPUT and PRINT, GOTO, GOSUB, etc.

The 6800/09 version of LAB BASIC allows disc file handling using SAVE, LOAD, CAT, READ, WRITE, OPEN, etc.

Time

Measuring time is important in most control applications, and here LAB BASIC has a few innovations to offer (again, credit is due to Dr Kiss).

If an interrupt timer is present in the system, LAB BASIC reserves the variables T,U,V,W,X,Y,Z for holding various timings:

T,U,V contain the current time in milliseconds, seconds and minutes respectively

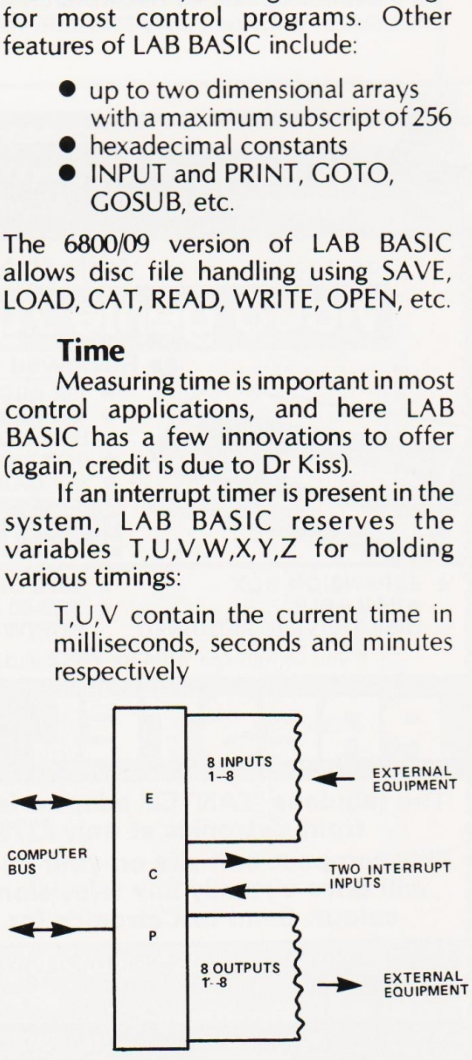


Fig. 1. The I/O port that LAB BASIC requires to operate.

W,X contain the time of the last 'event' (an event is described below) in milliseconds and seconds respectively
Y,Z contain the difference between the time of the last external interrupt and the time of the most recent event in milliseconds and seconds respectively

All of these variables may be used in the usual way in assignment and IF statements etc. If no interrupt timer is present then the variables behave as normal BASIC variables.

One new command 'INIT' zeroes all the time variables and starts the clock. INIT is carried out automatically when a program is run.

Control Statements

The power of LAB BASIC comes from its extra control statements, which are listed and described below. It is important to remember that the input/output lines of the current ECP are numbered 1 to 8 and that a reference to zero is a reference to *all of them*. Hexadecimal constants are indicated by a $ prefix, ie $F = 15.

CONTROL = n	Sets the current ECP to port n, used when more than one ECP is present
PINIT	Initialises the current ECP
ON 'expression'	Turns on the output line given by 'expression'; all other lines are unaffected, eg ON I,ON 0
OFF 'expression'	Turns off output given by 'expression'; all other lines are unaffected
SET 'expression'	Sets outputs corresponding to the ones in the binary equivalent of 'expression' For example SET 05 turns lines 1 and 3 on (ie 5 = 00000101) but ON 5 turns line 5 on
RESET 'expression'	As SET but resets lines to zero
FLIP 'expression'	Changes the state of the output indicated by the expression; all other lines are unaffected
PULSE 'expression1' 'expression2'	Changes the state of the line given by expression1 for the time (in milliseconds) given by expression2. All other lines are unaffected
DELAY 'expression'	Does nothing during the number of milliseconds given in 'expression' then continues
DTOA 'expression'	Set the outpt of a D to A convertor to be proportional to 'expression'.

Three new functions are used in LAB BASIC to obtain input from peripherals:

SENSE ('expression')	The value of SENSE is the state (0 or 1) of the input line indicated by 'expression'. If 'expression' is zero then the value of SENSE is the decimal integer corresponding to the binary number represented by the inputs
AWAIT ('expression')	As for SENSE but a delay is caused until the ECP changes by at least one input
ATOD ('expression')	Obtain a reading from an A to D convertor using the channel given by expression

There are two special conditional instructions:

ON ERR 'line number'	When an error occurs control transfers to line number specified. The error number is passed in a new variable '@' and control is returned to the main program by a GOTO
ONIRQ 'line number'	When an interrupt occurs control is transferred to 'line number' by a GOSUB 'line number'. Control is returned to the main program by a RETURN.

Finally, there are the usual PEEK (examine a memory location) and POKE (change a memory location) commands.

It is important to remember that 'expression' in each of the above can be any valid LAB BASIC expression. For example SET I*J or DELAY I+J are all valid. Also the new functions can be used in any LAB BASIC expression and anywhere that a LAB BASIC expression can be used. For example IF SENSE 3 = 1 THEN PRINT "ON" or PRINT ATOD(1) *2+1 are both valid.

Events

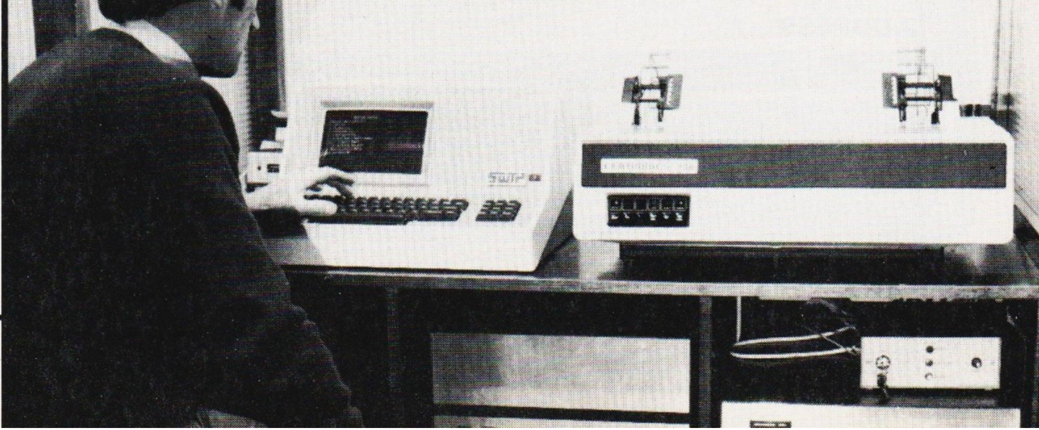
The execution of any of ON, OFF, SET, RESET, FLIP, PULSE, SENSE and AWAIT is called an 'event' and causes the time to be recorded in W and X. This may seem strange but in fact it is one of the reasons why LAB BASIC is easy to use and is able to make accurate timings. Used in combination with the interrupt input, event recording can make time interval measurements as short as one millisecond with very little programming (see examples). The basic principle involved is that any timings required are usually between some change in the input/output lines so it makes sense to record the time whenever the I/O lines change.

Interrupt intervals follow the same sort of reasoning as events. When an interrupt input is received the time difference between the last event and the current time is recorded in Y and Z. This is useful because usually we want to start something going via an event, then wait for it to finish, signalled by an interrupt and the time it took is what we are interested in.

Simple LAB BASIC Programs

The best way to discover the power of LAB BASIC is to use it, but failing that a few examples will help.

Program I — To Flash LED Number 1 At One-second Intervals. Assume that LEDs are connected to the outputs and switches to the inputs of the ECP.



```
10 PINIT        Initialise ECP
20 OFF 0        Switch off all LEDs
30 FLIP 1       Change the state of LED 1
40 DELAY 1000   Wait for one second
50 GOTO 30      Repeat
```

Program II — Reaction Timing. LEDs and switches are connected to the outputs and inputs respectively as in Program I. LED 1 is switched on after a random period and the time interval before the pressing of a switch connected to the interrupt input is measured.

```
10 PINIT          Initialise ECP
20 OFF 0          Switch all LEDs off
30 A = RND/3276   Generate a random number
  + 1             between 1 and 10
40 DELAY A        Wait A (a random number)
                  seconds
50 ON 1           Switch LED1 on
60 Z = 0          Zero interrupt time
70 IF Z = 0       Wait for interrupt to set Z
  THEN GOTO 70
80 PRINT Y,Z      Print result
```

In this example note how all the timings are made implicitly in Y and Z. In any other version of BASIC the program would simply loop forever at line 70, but in LAB BASIC when the switch is closed the time difference between the last event (the LED switched on) and the interrupt is placed in Y and Z. Hence Z suddenly becomes non-zero, as long as the reaction line is not exactly equal to one second (!) and the result is put in Y and Z.

Program III — Tone Generator. Assume that a high impedance loudspeaker or amplifier is connected to output number 1.

```
10 PINIT          Initialise ECP
20 OFF 0          Switch all outputs off
30 PRINT "PERIOD OF SQUARE WAVE IN
  MILLISECONDS"
40 INPUT P
50 PULSE 1,P      Mark
60 DELAY P        Space
70 GOTO 50        Repeat
```

The modification for other than a one to one mark space ratio is obvious.

Conclusion

It is difficult to demonstrate in a short article just how easy control programs are to write using LAB BASIC, and without being able to see or hear the results of the program examples it's not at all obvious what they do at each stage. In practice, users, whether they are students in the laboratory classroom or model railway enthusiasts, for example, quickly learn how to develop complex control sequences by watching what happens to their equipment as they try out different programs. Remember that LAB BASIC is an interpreter, and this means that a program can be written, run, and then added to very quickly.

The shortcomings of LAB BASIC are many, and no-one is claiming it is the best control language possible. But it is amazing how quickly experiments, etc, can be constructed without resort to machine code, with the added advantage that the resulting programs can be used on another machine with few changes.

For Further Information

6800 and 6809 (disc): R R L, PO Box 160, Welwyn Garden City.

6800 (cassette): Dr G Kiss, Department of Psychology, University of Warwick.

Z80 : Alan Cleary, Department of Psychology, University of Newcastle-upon-Tyne.

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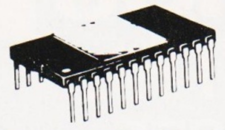

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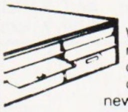

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2x22 way	3.20	3.65
2x25 way	3.60	–
2x30 way	4.15	–
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34	2.40	34	2.80
40	2.80	40	3.30
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1.0MHz	3.60	6.0MHz	2.70	18.00MHz	2.90
1.008MHz	3.50	6.144MHz	2.70	18.432	2.90
1.8432MHz	3.00	7.0MHz	2.70	36MHz	2.90
2.00MHz	1.50	7.168MHz	2.50	48.0MHz	2.70
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BOOK PREVIEW

A book that poses interesting questions and then gives you the answers has just been published. We present an extract

In an effort to answer some of the more common questions on the subject of computer memory we have turned to a newly published book. Entitled **Microprocessors: Your questions answered** it is written by Alec Wood and published by Newnes Technical Books at £4.95. We are extremely grateful to the publishers for their permission to reprint this extract which forms one of the chapters of the book.

How does the memory work and what are meant by bit organisaton and word organisation?

Microcomputer memories use semiconductor storage elements (cells) arranged in arrays. Each cell can hold one bit of information (a 1 or a 0). Any particular type of memory chip might have its cells arranged in one of two ways. It can either be organised so that each individual cell can be adressed and read or written into separately (bit organisation), or instead, a fixed number of cells are addressed and read or written into at the same time (word organisation). Typical semiconductor memory chips might have between 256 and 16 384 separate storage elements in one dual in line package.

We have already seen how a flip-flop can be used as a temporary store in registers so let us look next at how a flip-flop can be used in memory of the read/write (RAM) type.

Each memory cell is a simple S-R flip-flop. A logic network such as shown in Fig. 8.1, implemented by a suitable combination of the

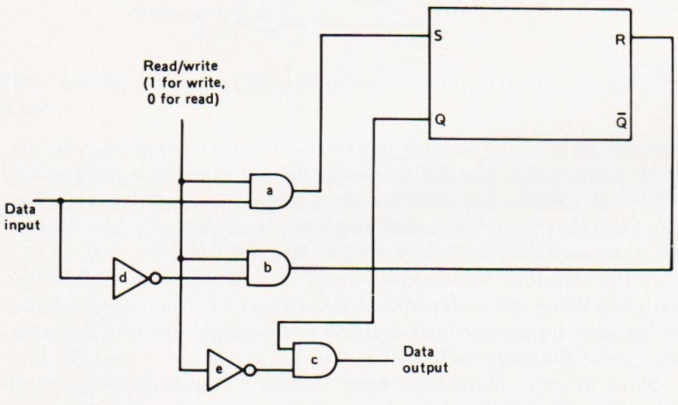


Fig. 8.1. A memory cell

appropriate gates on the memory chip itself, can be used either to route data into the flip-flop for a write, or to read information out from it for a read.

Consider the flip-flop shown in Fig. 8.1. If the read/write line is set to V+ then the two ANDs (a) and (b) each have one input set to V+. Therefore if, at the same time, the data input is set to V+ then the output of (a) is V+ and the output of (b) is zero because the NOT operation (d) inverts the data V+ to a zero.

The flip-flop's set input (S) is therefore V+, and its reset input (R) is zero. So the flip-flop is set and stores a logic 1. During this write, the read/write signal is inverted by the NOT operation (e), therefore AND (c) is disabled and there is no output from it.

Similarly, if the data input is zero at the same time as the read/write line is at V+ then the flip-flop is reset and stores a logic 0.

In order to read from the cell the read/write line has to be made zero. This disables (a) and (b), preventing data from being read in, and enables (c) because the read/write signal is inverted by (e). The output of (c) is therefore equal to the value of Q, i.e. a logic 1 if the flip-flop is set and Q = V+, or a logic 0 if the flip-flop is not set and Q = 0.

Common microcomputers usually have eight-bit data buses and therefore have to store eight-bit words in each memory location (address). If we use memory chips that are bit organised we require eight of them with their address lines paralleled. The separate data outputs D_7, D_6, D_5, D_4, D_3, D_2, D_1, D_0, are taken one from each chip, as shown in Fig. 8.2.

If each chip contained 256 cells this would give a memory of 256 words × 8 bits each and would require eight address lines (A_0 to A_7). If each chip contained 1024 cells this would give 1 K byte of memory, i.e. 1024 × 8-bit words, and require ten address lines (A_0 to A_9).

Instead we could use word organised chips and these would be connected in a similar manner. The arrangement shown in Fig. 8.3 would give a 256-word × 8-bit memory (¼ K byte) and uses two 256 × 4-bit word memory chips.

Larger memories can be made up from chips by using an input called chip enable (CE). When this input is set at V+ the chip can be written into or read out of, but when chip enable is zero the chip can be neither written into nor read from.

A 1024-word × 4-bit memory can be implemented (as shown in Fig. 8.4) from four 256-word × 4-bit chips even though they only have eight address inputs.

Each memory chip contains a 256-word × 4-bit memory. The A_0 address lines of all the memory chips are connected together.

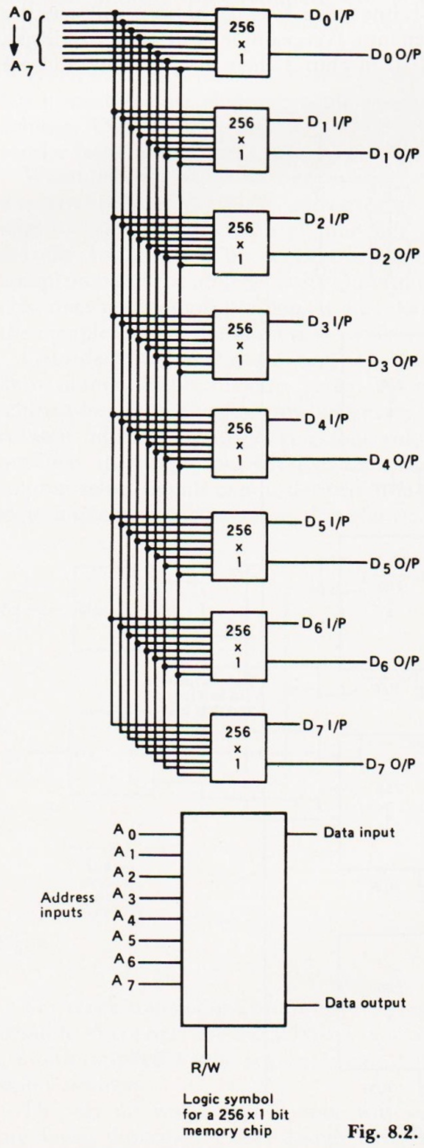
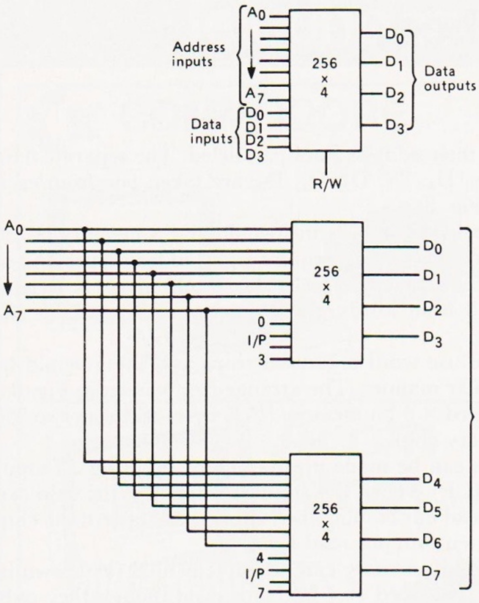


Fig. 8.2. A 256 × 8-bit memory

Fig. 8.3. Logic symbol for a 256 × 4-bit memory chip



Similarly all the A_1 A_2 A_3 A_4 A_5 A_6 and A_7 address leads are connected to each chip in turn. Signals placed on these address lines will therefore address one word in each of the four memory chips.

The chip enable lines from each chip are not connected together so only the chip whose CE line has a V+ signal on it will actually give an output or be written into. For example, if we want to address word 14 (binary 00001110_2) of chip 3 then the following address signals are required:

A_0	0	A_6	1
A_1	0	A_7	0
A_2	0	CE1	0
A_3	0	CE2	0
A_4	1	CE3	1
A_5	1	CE4	0

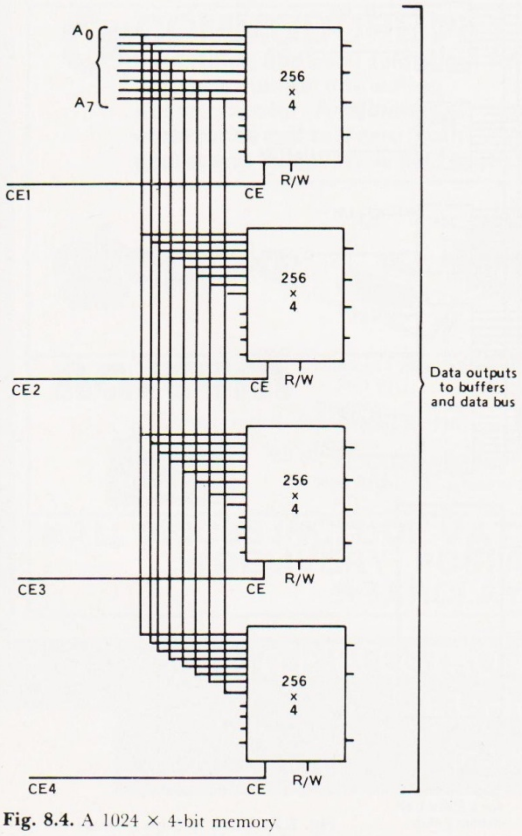


Fig. 8.4. A 1024 × 4-bit memory

How are the chip enable signals derived?

Let's examine the last 1024 × 4-bit memory. 1024 words require ten address lines ($1024 = 2^{10}$). The first eight, A_0 to A_7, are connected as shown, and the other two, A_8 and A_9, are used to derive the CE1, CE2, CE3 and CE4 signals.

Fig. 8.5 shows a circuit that will generate the four chip enable signals required from the two address bus bits A8 and A9.

CE1 will only be V+ if $\overline{A9}$ and $\overline{A8}$ are both V+, i.e. A9 = A8 = 0. CE2, CE3 and CE4 will then have zero outputs. Therefore for addresses

from A9 A8, A7 A6 A5 A4 A3 A2 A1 A0
0 0, 0 0 0 0 0 0 0 · 0
up to A9 A8, A7 A6 A5 A4 A3 A2 A1 A0
0 0, 1 1 1 1 1 1 1 1

only the 256 words stored in chip 1 will be selected. For the next 256 addresses 0 1, 00000000 up to 0 1, 11111111 only the 256 words stored in chip 2 will be selected because an input of A8 = 1 and A9 = 0 gives CE1 = 0, CE2 = V+, CE3 = 0 and CE4 = 0 since (b)'s inputs are A8 = V+ and $\overline{A9}$ = V+.

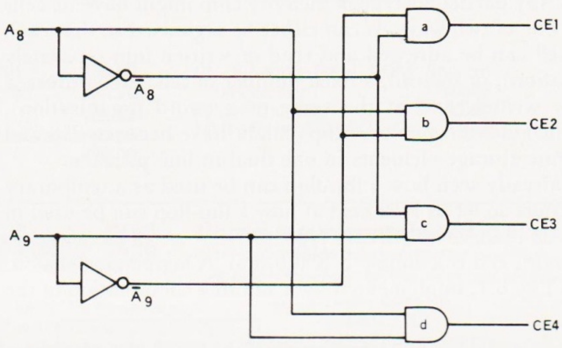


Fig. 8.5

Similarly for addresses from 1 0, 00000000 to 1 0, 11111111 then only the 256 words stored in chip 3 are selected because $\overline{A9}$ = 1, A8 = 0 gives CE1 = 0, CE2 = 0, CE3 = V+, CE4 = 0. For addresses from 1 1, 00000000 up to 1 1, 11111111 only the 256 words stored in chip 4 are selected because A9 = 1, A8 = 1 gives CE1 = 0, CE2 = 0, CE3 = 0, CE4 = V+.

A 1024-word × 8-bit memory can be achieved in a similar way with two 256 × 4-bit chips paralleled in each of the positions shown in Fig. 8.4. Larger memory systems can be constructed in a similar way using the chip enable input.

Some memory chips have more than one chip enable input and this helps to simplify very large memory systems. For instance, although a microprocessor with a 16-bit address bus can only address 64K bytes of memory, several 64K byte banks can be addressed by paralleling their address lines and then enabling only one of the banks by the use of chip enable inputs selected using an input/output instruction from the microprocessor. This is known as memory bank switching.

One of the latest memory chips is the CMOS-implemented 5101 low-power 1024-bit static RAM which comes in a 22-pin dual-in-line package and requires only a single 5 volt supply.

The chip is word organised as 256 words each four bits long. The storage cell in a chip of this type consists of two of our 'basic inverter units' connected together as an S-R flip-flop (see Chapter 6 'Registers').

A typical memory chip arranged in the same way as the 5101 contains 1024 of these cells arranged as 32 rows by 32 columns.

There are eight address inputs and the first five can be used to address any one of the 32 rows because 11111 is the binary number for 31_{10} and along with the binary address 00000 this gives 32_{10} different addresses:

00000	00001	000010	00011	00100
1	2	3	4	5
....	....	11101	11110	11111
		30	31	32

When one of the addresses is entered at the five address inputs A_4 A_3 A_2 A_1 A_0 it passes through buffers and into a row decoder which sends out a V+ along the one appropriate row select line of the 32 possible.

The 32 columns are divided into eight groups of four and any of these eight groups can be addressed by the remaining three address inputs A_5, A_6 and A_7 because 111_2 is decimal 7 and along with zero this gives eight different addresses.

When one of these addresses is entered at the address inputs A_7, A_6 and A_5 it passes through buffers and into a column decoder which only sends a V+ signal to the cells in the one appropriate column of the eight possible. Only the one address at the coincidence of the row and column decode outputs is thus enabled. The read/write control signal then determines whether this address is read from or written into. Thus any one of 256 unique four-bit words can be located in the memory chip using a five-bit row address and a three-bit column address.

The actual circuitry for selecting, and then reading from, or writing into, each cell varies from one memory chip type to another.

What happens to all the data inputs and outputs from each cell?

The D_0 inputs to the first cells in each column of each row are connected together and go to the D_0 chip input. The other cells are connected to the appropriate chip inputs. Data at the chip inputs is only written into those cells whose columns and rows are simultaneously enabled by the address inputs.

All the D_0 outputs from each column and each row are 'OR'ed' together and then connected to the D_0 chip output. The other data outputs from the other cells are connected in the same way to their respective chip outputs. Data is only read from those cells whose columns and rows are simultaneously enabled.

How are the memory chips themselves connected to the data bus?

Connection of memory chips to the data bus can be achieved with multi-input OR gates. However, some chips have on-chip Tri-State Output (TSO) buffers. (Tri-State is a trademark of National Semiconductors Ltd.) These eliminate the need for OR gates and enable them to be connected directly in parallel with all the other memory chips. Tri-state output means that they can either have an output of V+ for a logic 1, of zero for a logic 0, or go high impedance (high Z) when the chip is not being read from, which effectively is like unplugging the output from the data bus.

How are these three states achieved?

They are implemented in CMOS by a tri-state buffer whose logic is such that a complementary pair of P and N channel MOSFETs can either be turned on one at a time, or both off at the same time. See Fig. 8.6.

One tri-state buffer is required on each data output line. Output enable is set to V+ to enable the output, and to zero to disable the output, and set it to high impedance.

If there is a zero on the data line we want the buffer output to be zero when output enable (OE) = V+ and it will be if the N channel MOSFET is on, i.e. its gate is at V+, and the P channel MOSFET is off, i.e. its gate is also at V+.

If (a)'s inputs are 0 and V+ its output is V+. The inputs to (b) are both V+ therefore its output is V+. The P channel MOSFET is therefore OFF and the N channel MOSFET is ON so the buffer output is zero.

If now the data output is V+ and OE is V+ then the P channel MOSFET is ON and the N channel MOSFET is OFF. The buffer output is therefore V+.

If at any time output enable is zero then no matter what the data input is the output of (a) will be V+ and the output of (b) will be zero so both the MOSFETs will be off.

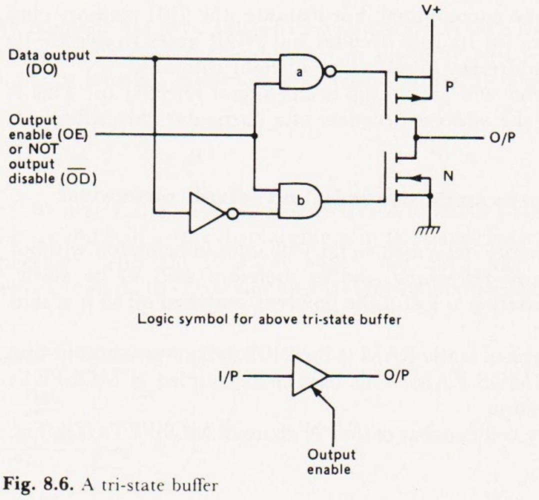


Fig. 8.6. A tri-state buffer

The resistance of a MOSFET when off is about one million million ohms (10^{12}) so the output is effectively unplugged from the data bus and is said to be high impedance.

How do the address decoders work?

Binary addresses are used because this reduces the number of external address lines required. For instance, a ten-line address input to a memory chip can uniquely define 1024 different addresses within that chip.

When the binary address reaches the memory chip via the address bus it has to be decoded to provide a signal to a particular row and column. This can be achieved quite simply by using logic gates in a similar fashion to the way that the chip enable signals were derived.

When the address reaches the memory chip it is often latched into a register of flip-flops which allows the address to be present on the address bus for only a short time but available to the memory decoder for longer. This register also automatically produces the complement of the address at its $\overline{Q}$ outputs. If a particular memory chip does not contain flip-flops it must have NOT gates to produce the complement of the address because this is used by the decoder.

Consider the simple case where we want to address a four-row by four-column, 16-bit, memory array. We therefore require two row address inputs to give four row addresses 00, 01, 10 and 11 and two column address inputs to give four column addresses. This will produce 16 unique one-bit locations in memory. The row and column select signals can be derived from the binary addresses by a logic implementation such as that shown in Fig. 8.7.

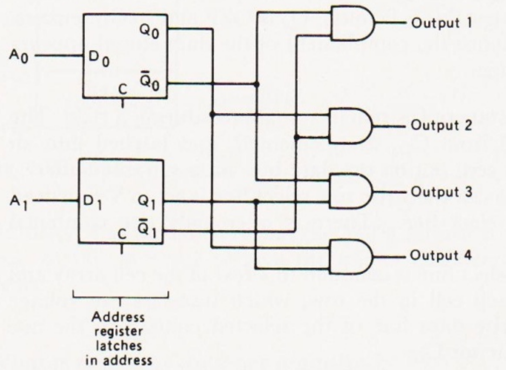


Fig. 8.7

The clock connections to the address register are not shown. It is possible to connect the clock pulses via control circuits so that they are only applied to the register when it is required to change the stored address.

This circuit works in the same way as the chip enable circuit previously described. Other decode circuits implemented with different gates may be encountered. For instance, the 5101 memory chip uses AND gates for its row decoder but NOR gates to decode its three column addresses to select one of eight columns.

Sometimes you will see a chip select signal referred to. This is used to enable the address decoders of a particular chip when it is selected.

What are meant by static, dynamic, and volatile memories?

The type of memory described so far will store information without the need for any refreshing and is therefore said to be static. However, information is lost if the power is switched off so it is said to be volatile.

A common type of static RAM is the 2102 sixteen-pin dual-in-line 1024 × 1-bit NMOS RAM. This uses cross-coupled N MOSFETs to store information.

Each memory cell consists of four N channel MOSFETs (see Fig. 8.8).

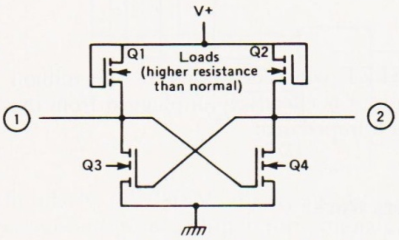


Fig. 8.8. The 2102 'basic' memory cell. This is a pair of MNOS inverters arranged as a flip-flop

Data is stored as a positive charge on the gate of either Q_3 or Q_4 where it turns the appropriate MOSFET on.

Assume Q_3 is ON, i.e. positive charge is stored on its gate. Current can now flow through Q_1 to ground. Point (1) is therefore near zero volts. (The actual value depends on the ratio of the resistances of Q_1 and Q_2 when they are on.) Q_4's gate is therefore at, or very near, zero volts so Q_4 is OFF. Q_2 maintains the charge on the gate of Q_3 by replacing any charge that might leak away. The storage cell will therefore remain in this logic state until it is changed by a write and this also applies if Q_4 is on and Q_3 is off.

Another common type of RAM cell is dynamic RAM in which data is stored as a charge on a capacitor. A three transistor NMOS dynamic memory cell is shown in Fig. 8.9.

MOSFET Q_4 is common to all memory cells in a column of the array and is used to pre-charge capacitor C_D.

To read from the cell, C_D is first pre-charged to a voltage very close to V+. This is achieved by MOSFET Q_4 whose gate is connected to NOT CHIP ENABLE. The read line which is common to a row of the array is set to V+ and this turns on Q_3. If the voltage stored on C_G is a logic 1 (i.e. very nearly V+), Q_2 is ON and so C_D is discharged via Q_3 and Q_2 to ground. If, however, the voltage stored on C_G is a logic 0 (i.e. 0 volts), Q_2 is OFF and so C_D remains charged at V+. Hence the complement of the data stored appears on the read data line.

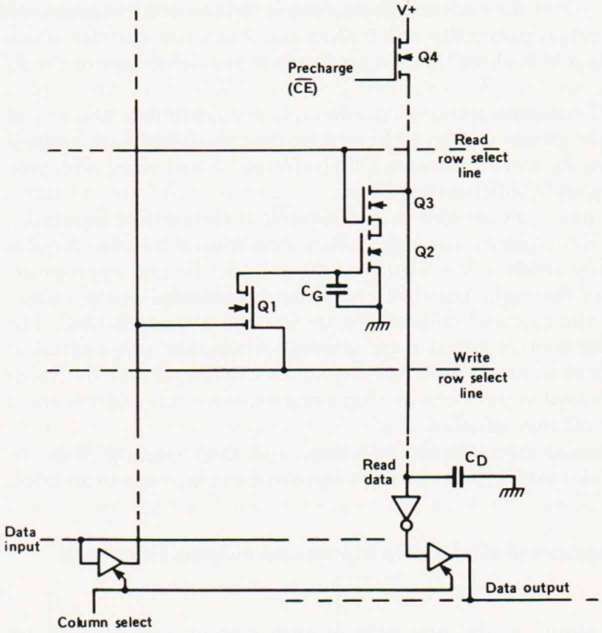


Fig. 8.9. An NMOS dynamic memory cell

Notice that the state of C_G remains unaltered during a read. The data may be read from C_D, complemented, and latched into an output register, or sent out on the data bus via a suitable buffer.

To write into the cell the write row select line is set to V+ instead of the read row select line. (There is often only one combined read/write input.)

The write row select line is common to a row of the cell array and turns on Q_1 in each cell in the row, which transfers the voltage present on the write data line of the selected column to the one selected cell's capacitor C_G.

The read row select and write row select signals for each row can be obtained by 'ANDing' the read and write signals with the appropriate row select signals from the row decoder.

Although readout is not destructive the charge on capacitor C_G deteriorates because of leakage. It therefore has to be refreshed by special refresh circuitry that reads the contents of the cell and writes it back in to the same cell at frequent intervals. This circuitry is incorporated on the Z80 MPU chip but more usually has to be provided separately.

How is read only memory constructed?

Read only memory (ROM) can be thought of as an array of selectively open or closed unidirectional contacts (which only pass current one way) as shown in Fig. 8.10.

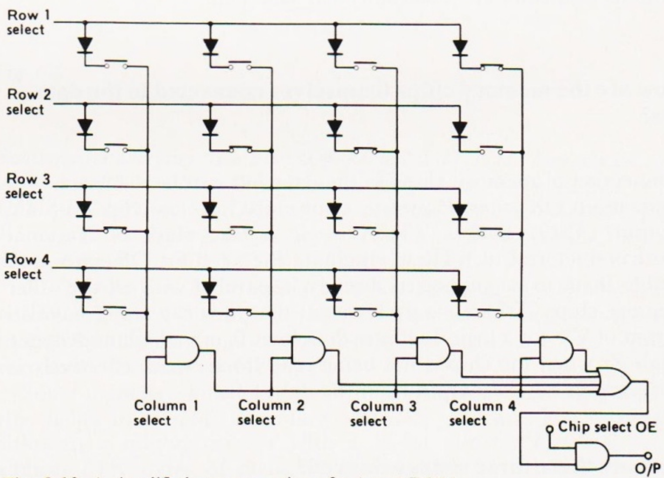


Fig. 8.10. A simplified representation of a 4 × 4 ROM

Notice that it is very similar to RAM but of course there is no write circuitry. The row and column select lines are obtained from the address lines in the same way as for RAMs and individual 'cells' are addressed and read from in much the same way as in RAM.

Different types of ROM exist and their major differences are in the way the open or closed contacts are formed. In mask programmed ROMs the contacts are selectively made or excluded during the final stages of production.

In programmable read only memories (PROM) the contact is constructed from fusible material that can later be opened allowing the information stored to be programmed by the user after the device has been manufactured.

Erasable programmable ROMs (EPROM) allow the programmed contacts to be restored to their original states and then reprogrammed.

There are two basic technologies in existence, bipolar and MOS. Their primary difference is access time. (Time taken for the data at a specific address to become available.) Bipolar access times are about ten times faster than MOS. Bipolar transistor circuits take up more room on the chip than equivalent MOS circuits and are available in 1K, 2K and 4K bit sizes. MOS ROMs are available in sizes up to 16K bits.

EPROMs are only manufactured in MOS technology.

The first electrically programmable read only memories (PROMs) used nichrome fuses and heavy currents were used to blow these open during their programming.

If the row is selected during a read then row select = V+, the transistor switch is ON and if the fuse is intact then the column is connected to V+ and gives an output of V+ when 'AND'ed' with column select at the foot of the selected column. If the fuse is blown the output of the selected column is zero.

Nichrome fuse PROMs suffered from 'growback', i.e. after a period of time some of the fuses reconnected. This problem has been overcome by using polycrystalline silicon as the fuse material instead of nichrome.

ROMs and PROMs are also produced using MOSFETs in place of bipolar transistors. However erasable PROMs are *only* produced with MOS transistors of a special type known as Floating Gate Avalanche-injection Metal Oxide Semiconductor transistors (FAMOS). Think of these as P channel MOSFETs with no external connection to their gates.

What are backing store memories such as tape cassettes and floppy disks used for?

These are useful because they are non-volatile and large quantities of data and programs can be stored permanently on them ready for future use. If we wish to store data on a cassette (i.e. create a file) then access time can be slow, especially if the data required is near the end of the tape, because the whole of the tape has to be scanned through before the required data is found.

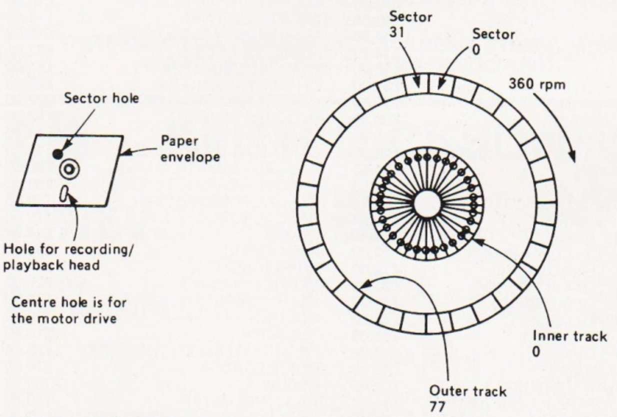


Fig. 8.13. The IBM 3740 disc system (capable of holding up to 243 000 bytes). This system uses one sector hole for each sector (a hard sectored disc) and hardware locates the correct sector. Some systems have only one sector hole and software then locates the other sectors (a soft sectored disc)

This is overcome in the floppy disk which stores data in magnetic form on a disk kept, and used, in a thin paper envelope. The data is recorded in serial concentric tracks. (Not in a spiral like a record.) Each track is divided into segments. The read/record head can be positioned directly to any sector of any track under software control. This greatly reduces access time compared with a cassette tape. It is, however, slower than semiconductor RAM and ROM.

What is bubble memory?

Another type of magnetic memory falling between RAM and floppy disk is the bubble memory. Small bubbles, or regions of magnetism, are formed in a sheet of magnetic material. These can be read in serial form. Bubble memories are non-volatile and their greatest advantage is that large quantities of information can be stored cheaply in a small area – more than one million bits in one square centimetre. Bubble memories give huge amounts of storage but at the expense of very high speed.

What is meant by page addressing?

All memory has to be addressed by the address bus. If this is a 16-bit address bus then each address can be represented by 16 binary digits or four hexadecimal digits (see Chapter 3). For instance:

1101	0010	1011	1110
D	2	B	E

The first half of the address is referred to as the page number and the second half as the displacement in the page. Eight binary digits therefore represent $2^8 = 256$ pages and each has 256 locations represented by the least significant eight binary digits of the address.

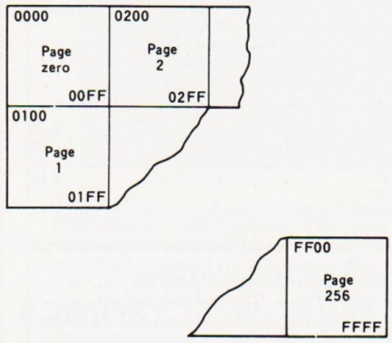


Fig. 8.14. Page addressing

Page zero is thus addresses with the first two hex digits zero, 00 00 to 00 FF ($0–255_{10}$). Page 1 is addresses from 01 00 to 01 FF ($256_{10}–511_{10}$), page 2 addresses from 02 00 to 02 FF ($512_{10}–767_{10}$) and so on up to page 256 which is addresses from FF 00 to FF FF ($65281_{10}–65535_{10}$).

What is a memory map?

This is a diagram showing where, in the 65 536 possible addresses, particular types of the microcomputer's memory are located. The memory map often also conveys other information about the use of particular memory addresses. It is important to stick to the manufacturer's recommendations as there must be memory of the

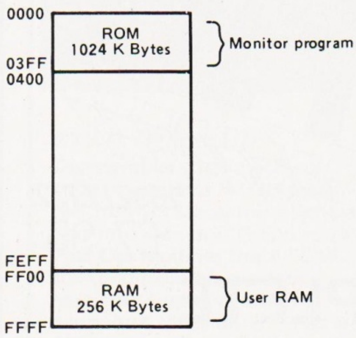


Fig. 8.15. A memory map

ROM type at the address that the MPU returns to after being reset (e.g. 00 00) in order to give the microcomputer its initial intelligence.

What is meant by memory mapping?

This is a technique of implementing input and output from the microcomputer by addressing input and output ports as if they were memory locations. So addressing external devices is the same as reading or writing to memory. Some systems provide separate input and output instructions instead of using memory mapping I/O techniques.

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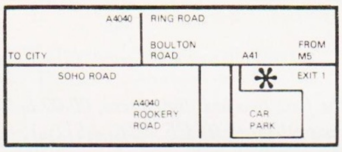

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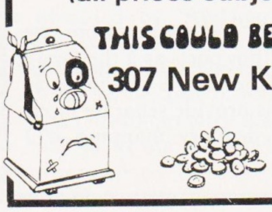

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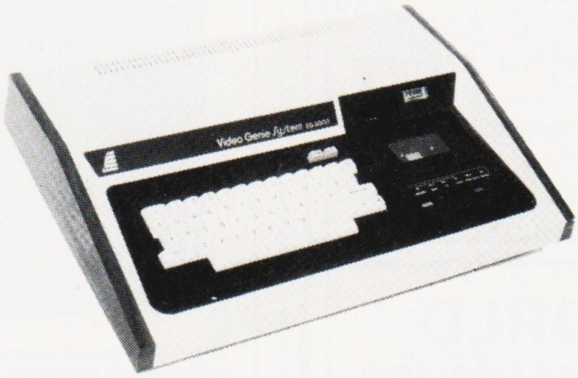

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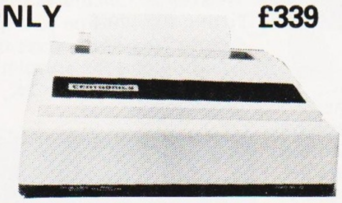

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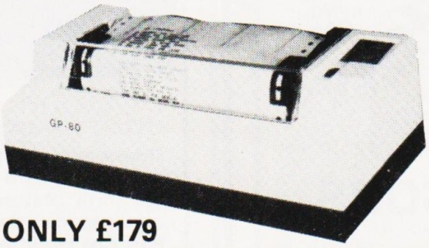

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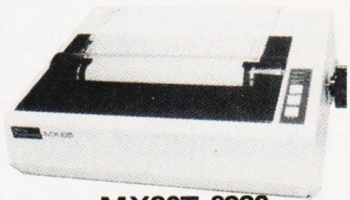

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TANDY-GENIE CONVERSIONS

R N Braybrooke

Small conversions give general compatibility

Ever since the introduction of the Video Genie just one year ago, it has been generally agreed that the Genie has not been fully compatible with the Tandy TRS-80. Certainly in the case of the early Genies, the absence of the 'CLEAR' and 'RIGHT ARROW' keys was a major obstacle to overcome, especially when using Machine Code programs. Since all new Genies have these keys fitted as standard and it is possible to have them fitted to older models, this problem has now largely been solved. It is true that it is not possible to enter double sized character mode from within software control, ie by using CHR$(23), but double spaced normal sized characters are displayed. This is a minor difficulty and of little real importance.

The BASIC interpreter in both machines is contained in 12K of ROM and were written by the same company, Microsoft. All BASIC commands execute the same function on both machines, therefore all programs written for the TRS-80 and not using Machine Code I/O routines should operate correctly on the Video Genie. The last sentence should have given you a clue to the most important, but least known, incompatibility found on the Genie. Any TRS-80 owner with a printer will tell you that there is a way of testing, from within a program, whether or not the printer is connected. This can be achieved by inserting the following line into your program:

```
80 IF PEEK(14312) >127 THEN PRINT"*
   * PRINTER NOT READY * *"
```

This line tells the computer to PEEK at memory address 14312 (which is the printer I/O address), and return its value. If the value returned is 255, then the printer is not connected, if the value is 63, it means the printer is connected. This line will work on any TRS-80 program which incorporates a line printer. It will not work on a Video Genie. At this point Genie owners will be rushing to their keyboards — only to find that their computer hangs up. Do not despair, I shall provide Genie owners with a solution a little later on.

Coding It?

Although the BASIC in both machines appears on the outside to be identical, several important differences come to light when we delve into machine code. Programs which use LLIST and LPRINT statements will work perfectly on both machines, provided they do not call up the routine above. This is why.

On the TRS-80 it is possible to 'Scan' various peripherals by examining memory address inside the computer; this is known as memory mapping. These various addresses, together with their respective functions, can be found on page D/2 in the Tandy Level II Basic Reference Manual. The Video Genie also has some memory mapped functions, but the printer and, I believe, the cassette latch are not. On the Genie these two devices are 'ported,' not memory mapped. In itself this does not present any difficulty when writing your own software, but difficulties can arise when using 'memory mapped' software. If you own a Video Genie and use a printer, type in the following one line program:

```
10 CLS:PRINT INP (253)
```

RUN this program once with the printer turned on, and once with the printer turned off. Notice the difference? It returned a different value in the same way as the PEEK(14312) command did on the TRS-80. With this information it should be possible to see how to modify programs using PEEK(14312) to INP(253) for use on the Genie.

As far as BASIC programs are concerned, this should be the only difficulty you should encounter. I would of course be very interested to hear of any other difficulties users have encountered.

So far we have covered only half the story, doubtless Machine Code programmers can guess what is coming next.

Modifying BASIC programs is relatively simple, modifying Machine Code programs needs a little more thought. Before you start you will need a good monitor program. I have found MONITOR 3 (for cassette users) and MONITOR 4 (for disc users) ideal for this purpose, although any such program should be able to perform the same function. Note that the majority of machine programs will work perfectly on the Video Genie. Be absolutely certain that all your hardware is fully operational before attempting to modify software. I have found from my own experience that the disc version of Scripsit (and I would assume also the cassette version) do not operate correctly. Other programs include the Editor Assembler (from Tandy), the Electric Pencil and Level III BASIC. These programs all use their own printer driver routines: programs which call up the interpreter's own driver routine should not require modification.

Changes To Make

The object of the exercise is to alter the offending program from examining memory mapped driver addresses to calling up ports. I shall use the example of Scripsit (disc version) in showing all modifications.

Since we now know the theory of these modifications, we can now put them into practice. Memory address 14312 in decimal is 37E8 in Hex, so we now know what we have change. Port 253 is the address of the printer driver in decimal, in Hex this correlates to 0FDH. With this information in mind, we can now institute the following changes. Scanning through a listing of Disc Scripsit, I encountered the following lines.

```
5F63  3A E8 37  LD  A,(37E8H)
663F  3A E8 37  LD  A,(37E8H)
6650  3A E8 37  LD  A,(37E8H)
665E  32 E8 37  LD  A,(37E8H)
```

These four lines output a test signal to the printer to test whether or not it is on. If no signal is returned, the computer assumes that the printer is not ready. Since we already know that this memory address performs no such function on the Genie, the following modifications are needed.

```
5F63    DB FD    IN     A,(0FDH)
5F65    00       NOP

663F    DB FD    IN     A,(0FDH)
6641    00       NOP

6650    DB FD    IN     A,(0FDH)
6652    00       NOP

665E    D3 FD    OUT    A,(0FDH)
6660    00       NOP
```

These changes enable the test signal to be sent out to port 253, since the required signal is then returned printing can continue. These modifications were made to Disc Scripsit, however they can be applied to other problematical programs without difficulty.

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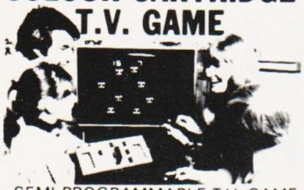

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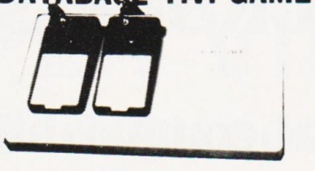

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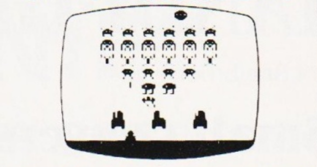

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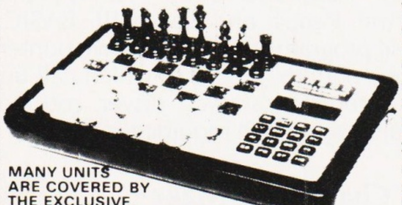

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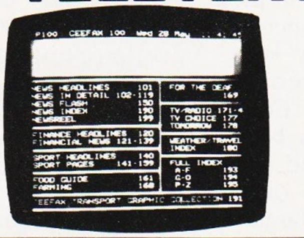

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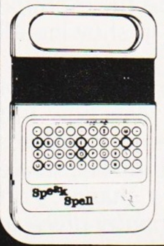

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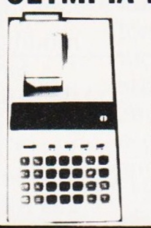

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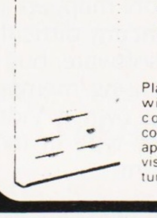

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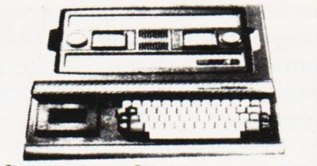

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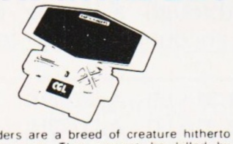

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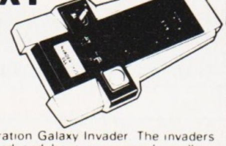

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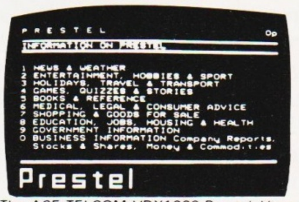

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SILICA SHOP

Dear Sir,
After reading Mr C M Jordan's letter in the September issue I could do little more than fume and froth at the mouth.

Man has done little else with his time on this planet except batter his neighbour in some way, initially with sticks, then swords, right up to the present threat of nuclear bombs.

The fact that we now have the capability to destroy ourselves with these weapons is correct but I cannot accept that a game can in any way contribute. It is a major fault of mankind that it has never been able to turn the other cheek and until (if) this can be achieved we will all live under the threat of whatever the military can invent.

May I congratulate you on the Holocaust program and perhaps for those who were offended by it make the recommendation that for them the name be changed to 'Knights of the Holy Land'?

Yours faithfully,
P S Bruce
South Norwood
London.

Dear Sir,
Writing in reference to the letter by C M Jordan in September's CT may I say that I endorse his views on the publication of the Holocaust program wholeheartedly. As a member of the Campaign for Nuclear Disarmament, and as one who has recently purchased a Sinclair ZX81, I must protest at the ludicrous nature of your reply.

To say that the only way people are likely to do anything about the threat of nuclear war is 'if they actually realise the kind of destruction that is likely to result' is perhaps true but nobody could possibly imagine the extent to which nuclear war would reach by watching a mere 'simulation' on their television screens.

Secondly, the very idea the 'Space Invaders' type machines and nuclear war are even comparable is not only naive and preposterous but dangerous as well. The real point is that we have no control over the arrival of 'cute little green bug-eyed monsters' whereas we have every control over whether we reduce our planet to ashes or not.

Yours faithfully
Tom Watkinson
Holsworthy
Devon.

(*Oh dear, poking a little bit of fun at an innocent reader seems to have backfired just a little. I've read this letter over and over and there are a couple of things I still don't understand, Mr Watkinson. Just what do the CND and Clive Sinclair's ZX81 have in common? Do you have to own one to become a member, or perhaps members are automatically suitable for ownership? Your comment about the programme 'War Game' is, I believe, based on not having seen it. From brief research it appears that parts of it were made in the late sixties and shown to medical students as an example of the sort of thing they might be expected to deal with. For something that was made this long ago to be still banned because the material included would be too shocking for the majority of the public is incredible. Your final comment about my naivety only serves to make me wonder whether you really do believe that 'we have every control over whether . . .'. We may all be able to cast our votes at Elections but, as yet, the various groups of people dedicated to disarming this country don't really seem to have got very far. And, this is definitely the end of that little controversy. Ed.*)

Dear Sir,
The Amateur Computer Club of North Staffordshire (ACCNS) meets on the third Wednesday of each month. Meetings are usually held in the Talbot Hotel, Station Road, Stone, and commence at 7.30pm.

We are a small and fairly informal group, with perhaps 12 to 20 people at each meeting. Members are encouraged to bring along their machines and we have a wide range between us — NASCOM, Tandy, Apple, Video Genie, Tangerine, Triton and Homebrew.

Our members' interests vary from professional to hobbyist, with the former often able to give valuable assistance with problems to the rest of us.

We welcome anyone who wishes to come along to our meetings, whether they own a computer or not, and whatever their level of knowledge of the subject. You would be able to get 'hands-on' experience of many different machines, and see a variety of programs running.

If anyone would like more information, please contact me, **not the Talbot Hotel**, *on Stoke-on-Trent 324639 in the evenings, or write to me at the address below.*

Michael Turner
Chairman
ACCNS
542 Lightwood Road
Lightwood
Stoke-on-Trent ST3 7EH.

Dear Sir,
I am a Microtan 65 owner and would like to pass on a tip to all those who have lovingly typed in 7K of BASIC and then found that they can't find the filename when they try to verify the SAVE.

As they will know, the only way to regain control is by a Reset, and goodbye to all your typing! To overcome this try the following 'Warm Start'.

After Reset type GE185 to which the response should be 'OK'. Now key in;

```
POKE 12,15:POKE 49,80:POKE
14,2:POKE 50,56
```

All should be back to normal.

I have never seen any corrections to the Micron Clock program published in March. Although the program runs it does suffer from some time warp. To overcome this the following bytes should be changed to bring it in line with GMT.

```
0BB8 From 8A to 98
0BBC From 3D to 3A
```

Yours faithfully,
P G Axton
Luton, Beds.

Dear Sir,
Having myself spent several years on (statistical) forecasting of all kinds, and football pools in particular, I found Mr Peckett's article (Computing Today, September 1981) of special interest. I have myself written a number of programs for forecasting football results, and I notice from his article's reference that he is familiar with the brief outline of my approach that I gave in the **New Scientist**.

There were some points that Mr Peckett made which I believe require some further clarification. I certainly agree with him about 'recent form' and I believe that his method of dealing with the league position by dividing the league into three is quite reasonable, although I myself have taken the ratio of points to matches played and considered the order of each 'league state' in its entirety.

One of the difficulties I had with Mr Peckett's description of his system was a semantic one. He says:

'First of all, suppose that the home team won its last home match and drew its last away, while the away team lost its last away match and drew last week at home . . . the data confirms that the chance of a draw (in this case) is only around 16%'.

What is not clear is whether the home team played in the order HW/AD, AD/HW, or even if these were successive matches; it could be that the record is AD/HL/HW and so on. Then it is unclear in the same way for the away team, or more so, since the words 'last week' are used: is this meant to be the same as 'last match'?

Later Mr Peckett says, in the understandable desire, indeed need, to economise on computer space:

'The way around this problem was to concentrate only on draws, without even being able to tell 'score' from 'no-score'.'

Since all possible combinations of two preceding matches for both teams sometimes lead to draws, the problem of 'concentrating only on draws' is not clear to me. As to the distinction between 'score' and 'no-score' draws, that can only be sensibly distinguished by goal difference and not by the (Markovian) sequential analysis. In fact it can probably be safely ignored.

One peculiar comment concerned the Scottish Second Division. He says they are 'not often' on the coupon and they follow 'laws known only to themselves'. The punter has to consider all matches and the Scottish Second Division does appear quite frequently (it is worth counting how often), and sometimes we have to deal with the Southern and other non-league matches. Given the appropriate newspaper, league tables can be found and the use of tables (if only for the last match) coupled with the league position can be used manually.

My more important concern though is the belief that the Scottish Second Division is essentially different. Two tests I have employed seem to dispute this. I took the number of draws in each of the three Scottish divisions for some six successive seasons and the number of draws in each averaged out, taking number of draws over *number of teams in the league, as: 5.0 for the Premier Division, 5.0 for the First Division and 4.9 for the Second Division (rounded off to the first decimal place). The second test showed no variation in either two or three successive results for the Scottish Second Division, or any other division in the UK. There are variations (not statistically significant) but they are no more noticeable in the Scottish Second Division than in any other.*

There are many other points to be made, with which I am sure Mr Peckett would, by and large, agree. The need for a 'random element' is clear, since as he says '(his method) has no chance of scooping the jackpot'. It is for this reason that my own programs all include 'unexpected draws' (the random element) in small proportions. I have outlined this in my **New Scientist** *article which deals with SORTS especially for the pupose. For more detail, I would refer to my previous book* **A Better Bet**, *which gives a detailed account of the whole procedure of pools gambling; an up-dated version* **The Best Bet** *I expect to appear next year.*

If I have appeared unduly critical of Mr Peckett's work, I would like to redress the balance by expressing the belief that he is working on the right lines, but both in his description and in his collection of statistical data, I think there is a lot more to it than he says: the goal difference is only one of many factors that he does not even mention. But to be fair, space hardly allowed the more detailed description that is so necessary.

Yours faithfully,
Professor F H George
Beaconsfield
Bucks.

Dear Sir,
Paul Williams' PET Lister in your September issue tempted me to buy a copy. The program seemed to be the answer to many of the problems I have had when trying to list my PET programs on an MX80 printer.

I carefully typed in the program using TIM. I double checked the entry and used the IPUG Disassembler as another check before trying out my first listing. All my program was printed out on one line! Not being interested in Computer Art I tied my two sons to the computer and demanded that they produce a working program.

I now have a very useful program which lists all my BASIC programs in a readable form. The corrections that were made, and which work for the MX80, are:

1) Possible printed errors
```
7530 should read A9  30
7534 should read A9  75
```

2) Patch for CR LF routine
```
7560 change to 20  3B  76
7597 change to 20  3B  76
```

3) Subroutine to force CR LF at end of line
```
763B  A9  0D       LDA #$0D
763D  20  D2  FF   JSR $FFD2
7640  A9  0A       LDA #$0A
7642  20  D2  FF   JSR $FFD2
7645  60           RET
7646  EA           NOP
```

I stress that I have only tried this with an MX80 printer. There are neater solutions to the problem but this method will not mess up Paul Williams' useful and well documented program. It is a great tribute to his work that we were able to find where our problem lay and how to solve it very quickly.

I do not like adding a space after reserved words only. If listings are for publication then spaces should be inserted in the program itself.

Since the PET Lister uses at least three characters for every one cursor or graphics symbol an 80 character line containing graphics may take well in excess of 210 characters to print. If your printer does not force a CR LF at the end of its printed line length then there will be overwriting. One possible way to solve this problem is to set the MX80 to the condensed character mode; PRINT#4, CHR$(15).

Many thanks, Mr Williams, for solving one of my problems and for producing such an elegant program listing.

Yours faithfully,
W G C Austin
Newcastle-upon-Tyne.

(*There must be something about the MX80 that I don't know because we've had several letters asking why the program doesn't work on them. Many thanks to you, Mr Austin, for solving the problem and I hope you remembered to untie your sons. Ed*)

Dear Sir,
Forgive me for re-opening the 'rounding' discussion, but I have recently been faced with a problem in this area, the solution may be of interest to you.

In connection with some lectures on perception, I was trying to generate a display of randomly placed points, transformed into a perspective field, which was to be output onto a printer with a rather coarse dot matrix. A conventional rounding rule was used to move the calculated positions of the points to the nearest printer positions and an adequate picture was obtained.

When, however, for the purposes of comparison a similar operation was performed with a regularly spaced field of dots, the use of systematic rounding rules produced a 'bending' effect. To avoid this a new rule was used, with complete success, and this is the corresponding code.

```
C  IN THE FOLLOWING ROUTINE A REAL
   VARIABLE -X-
C  IS ROUNDED, EITHER UP OR DOWN,
   TO THE NEAREST
C  WHOLE NUMBER IN THAT DIRECTION.
C  THE PROBABILITY THAT X SHOULD BE
   ROUNDED UP
C  IS EQUAL TO ITS FRACTIONAL PART
   L1=0
   L2=0
C  RAND IS A FUNCTION AVAILABLE IN
   DEC FORTRAN IV WHICH
C  RETURNS THE NEXT IN A SEQUENCE
   OF PSEUDO-RANDOM
C  NUMBERS UNIFORMLY DISTRIBUTED
   IN THE RANGE (0,1).
C
   RAN=RAND(L1,L2)
   IF (MOD(X,1.0).GT.RAN) X=X+1.0
   X=AINT(X)
```

In effect the decision whether to round up is left to the throw of a dice, which is loaded so that a number is more likely to be rounded to the nearest whole number but not certainly. Setting RAN=0.5 restores the conventional rule.

My apologies for the use of FORTRAN. I can read BASIC all right — otherwise I would be unable to make very much use of your excellent publication, would I — but I am not much good at writing it, all my intellectual colleagues who can are away on holiday.

I would be most interested to know if any of your readers use similar rules. If I ever have time I intend to try this out on other calculations where I suspect that a little 'fuzziness' might help.

Yours faithfully,
P H Tanner
Glasgow.

Dear Sir,
The article on upgrading the PET that appears in the September issue leaves a lot to be desired, giving the impression that almost anyone can carry out the operation successfully. This is just not the case, by the way what does the author consider a large wattage iron?

I have successfully upgraded four machines from 16K to 32K with the following method proving to be the best.

Mark the centre of each solder pad with a sharp inscriber. Drill out the pad with a 0.6mm drill. Clear the holes of swarf with a stiff brush, a toothbrush is excellent. Insert the IC sockets and solder in position.

The sockets should be of the low-profile type, TI's are the best. Some machines have the decoupling capacitors, 10nF, missing and they must be fitted, I prefer the resin dipped type.

The following program can be used to test the memory, highest location for 32K is 32767.

```
100 INPUT"ENTER START ADDRESS";S
110 INPUT"ENTER END ADDRESS";E
120 FOR M=S TO E
130 POKE M,0:IF PEEK(M) <> 0 THEN 190
140 POKE M,170:IF PEEK(M) <> 170 THEN
    190
150 POKE M,255:IF PEEK(M) <> 255 THEN
    190
160 NEXT M
170 PRINT"LOCATIONS ";S;" TO ";E"
    CORRECT"
180 END
190 PRINT"ERROR IN LOCATION ";M:END
```

I hope this will be of some use to the hardware hackers.

Yours faithfully,
M Carr
Sheffield.

(*Drilling through a plated-thru PCB does not sound the best of ideas to me but then perhaps it's just as safe as cooking the board with a desoldering tool. Ed.*)

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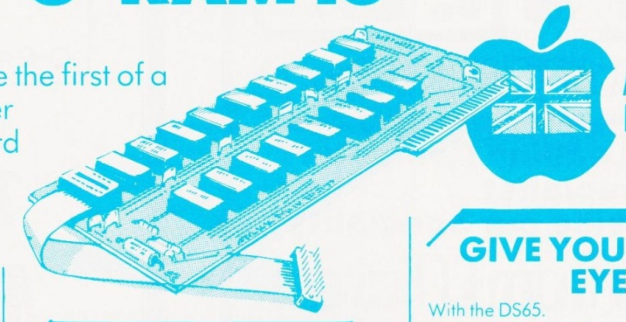

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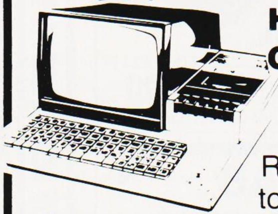

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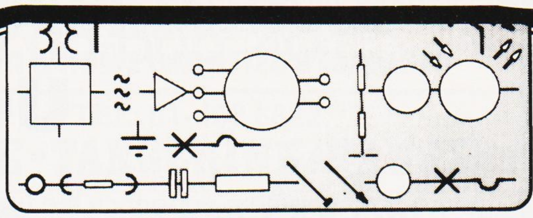

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ON-SCREEN INFO

Henry Budgett

With the 'Year Of Information Technology' looming we thought it was time to explain what it's all about

Next year has been dedicated to the science of Information Technology. Wonderful, you may well be saying, but just what is IT? The purpose of this article, together with its companion next month, is to introduce the two main systems that are currently in operation and available to the public.

As far as the average member of the public is concerned IT is probably represented by the occasional glimpse of the BBC's promotional Ceefax pages shown on BBC2 and that series of advertisements on ITV last winter for Prestel, so ably mimicked by the 'Not The Nine O'clock News' team.

These two public systems are known under a blanket name of Videotex: a name carefully put together from the Latin word *video*, meaning 'I see', and an abbreviated form of *text*. The last 't' has been lost in order to create the maximum possible confusion with another team, Teletext, which is the subject of this month's article.

Let me now present the two main contenders for the UK Information Technology Stakes. The first, at least in terms of its availability, is Teletext. This is a broadcast system: that is, it is transmitted in a similar manner to the normal TV programmes, and can only be received on a specially equipped television set.

The second contender is known as Viewdata — the implementation in this country has been given the name Prestel by British Telecom, the institution that set it up.

Although the two systems are similar in many ways they have one fundamental difference: Viewdata is a two-way system and users can interact with it, whereas Teletext can only provide information. This article will concentrate on the latter system but much of the discussion will hold equally true for next month as well.

An Historical Interlude

It is worth taking a little time to look at the history and development of text transmissions over the broadcast system. The idea of electronic news services is by no means a new one. Ticker-tape services for shares and news have been in operation almost since the start of telegraph operations and these have spread into the telex and teleprinter services available today. The trouble is that these are generally bulky and expensive, making their use in the domestic environment awkward.

With the spread of television services to the point, in the mid sixties, where almost every home had one, especially in the USA, it became obvious that the TV screen could be used in the same fashion. This was already being done by some of the cable TV services, again in the USA and Canada, where a scrolling display of news would cycle round every half-hour or so. Important newsflashes could be inserted but the basic problem was that it could take you half-an-hour to get the piece of information you require, by which time it would be half-an-hour out of date!

Proposals were made around this time to introduce a flashing dot onto the normal TV picture which would act as a transmission source for an information service. Hazeltine, better known in this country for the VDUs they produce, put forward a plan in 1973 using this type of system where a subcarrier signal of some 2-3MHz would carry information at a rate of 21K bits per second. The pickup would be a single photocell struck over the flashing dot and all decoding could be handled by a simple interface unit.

As an alternative to this method the actual make-up of the TV picture itself can be used. In the UK our TV pictures are made up of 625 lines. Only 575 of these actually contain picture information, eight are used for synchronisation, and the rest are blanked. Surely those spare lines could be used for something?

The first use of these blank lines was simply for test purposes: as the transmission times were extended the time available for test cards and other necessary system checks was reduced. So, as these lines are not seen unless one's set is badly out of adjustment, engineers regularly use a couple of lines for test transmissions.

The next use was by the IBA as a means of transmitting information between its regional services and the name given to the operation was SLICE (Source Labelling Indication and Control Equipment). This uses lines 16 and 328 on alternate field scans. (Only half of a TV picture is sent at any one time, it takes two scans to produce a complete frame which explains why some photos you see have a diagonal stripe across them).

This is really the basis of all modern Teletext types of transmission, and is in common use today for engineering purposes.

The Early Days

In the USA RCA proposed a system called Homefax which although transmitted using the above principles, produced its output on a printer, not the screen. It was in the UK, however, that the first real Teletext systems took shape.

By the end of 1972 both the BBC and IBA had teams of engineers working on experimental systems. The first to take to the air was the IBA's Oracle service (Oracle standing for Optional Reception of Announcements by Coded Line Electronics, but also having historical connotations). This took place in April 1973 and the magazine — that's the term for a collection of pages on Teletext — consisted of some 50 pages made up of 40 lines of 22 characters. Transmission rates were around one page per second. Initially only upper-case characters and figures were transmitted, but colour, lower-case and graphics were soon added. The BBC's Teledata system was soon to follow. This consisted of some 32 pages made up of 24 lines of 32 characters and, because the BBC used two scan lines to the IBA's one and a faster data rate, they transmitted at some two frames per second. The name of the BBC service was changed shortly afterwards to Ceefax, a corruption of See Facts.

It rapidly became obvious that to stand any chance of success a unified standard had to be agreed upon and a joint committee, together with the TV set manufacturers (BREMA), produced the initial specification for Teletext in January 1974. This allowed for up to 800 pages per channel, use of lines 17 and 18 of the field scan, a transmission rate of four pages per second and a format of 24 lines of 40 characters. The specification also included provision for colour, graphics and time coding among other things.

A further, advanced specification was agreed in 1976 which added more facilities including contiguous graphics, conceal/reveal and double-sized characters.

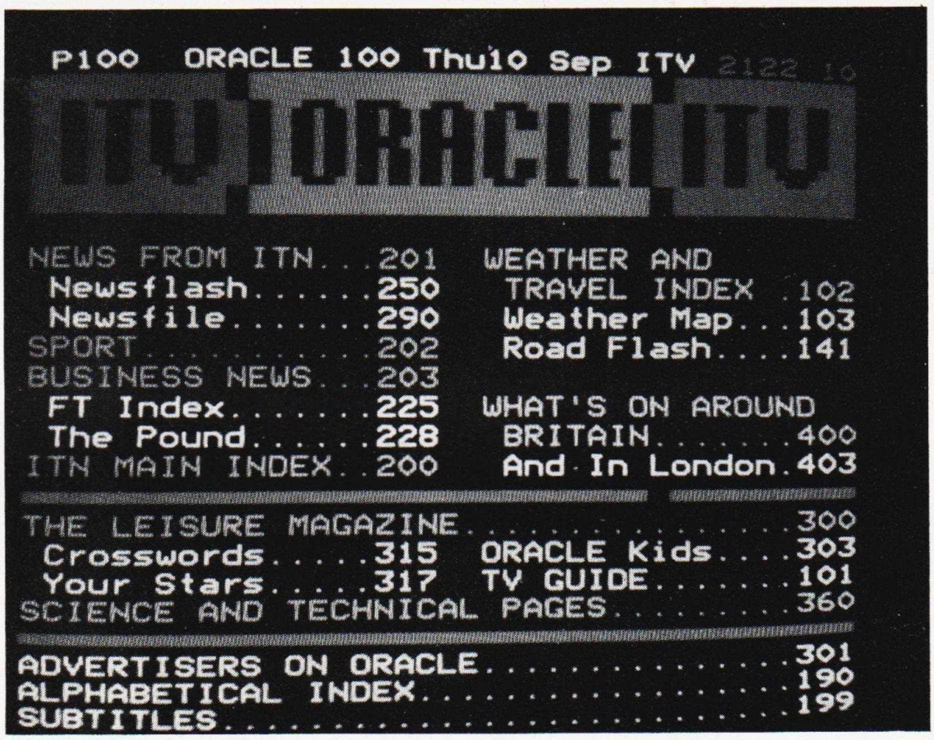
In foreign parts similar systems were tried in Germany and Sweden, the USA and Australia. France has developed a blanket system called Antiope that covers both Teletext and Viewdata type systems and Canada is also developing a Videotex service.

The Technical Bit

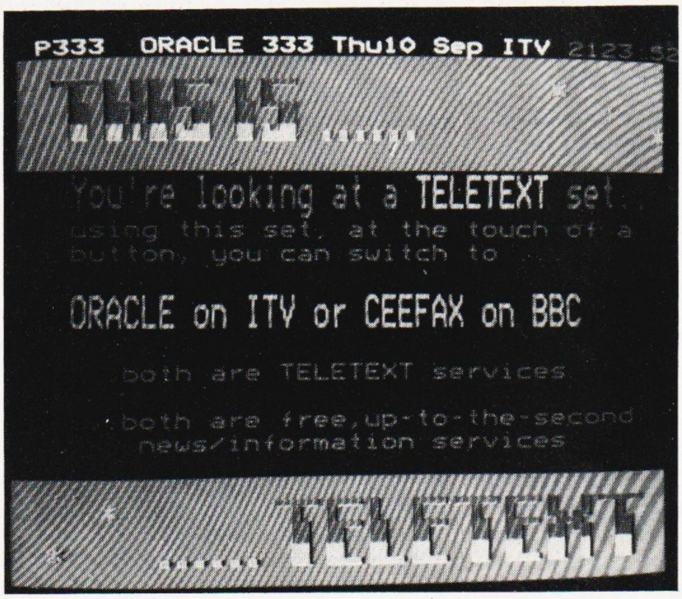
The current technical specification of Teletext is that the screen format consists of 24 lines of 40 characters and, in this and indeed all other aspects, both IBA and BBC services conform. Information is transmitted in the blank lines of the TV scan, as previously mentioned, and is thus a serial transmission (it couldn't really be anything else!).

However, the nature of the transmission itself is rather different to that which we expect from our knowledge of computer-based serial operations.

Devices such as cassette tape interfaces and printers or terminals invariably use an Asynchronous serial transmission system. This is because the operator cannot be expected to type data into the computer in a nice regular pattern so each piece of data must carry a synchronising pulse to let the computer know when it has started and ended. Typically each byte — a collection of eight bits, the standard 'word-size' for transmission systems — is preceded by a number of 'start bits', typically two. These indicate to the receiving device that a byte is on its way. Similarly, at the



IBA's Oracle service's main title page, the two BBC pages are very similar.



A test transmission page showing some of the facilities available on the system.

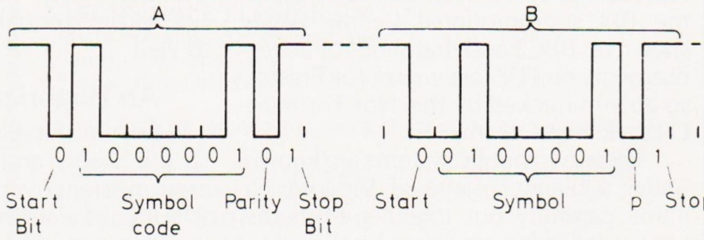


Fig. 1. What an Asynchronous serial bit stream looks like . . .

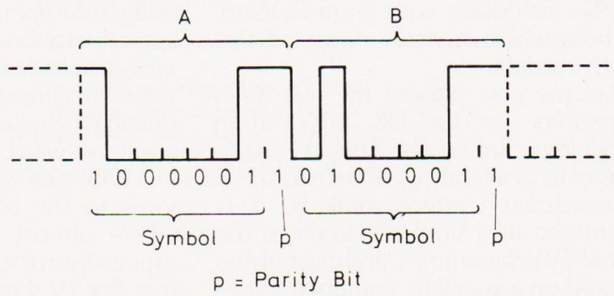


Fig. 2. . . . and its close cousin, the Synchronous serial transmission as used by Teletext.

end of each byte a 'stop bit' is sent, usually a continuous level rather than pulse and opposite in logic to the start bits. A typical pattern can be seen in Fig.1.

Because the transmission of Teletext information is a continuous process rather than a stop-start operation, a different method called Synchronous serial transmission can be used. Obviously some form of synchronising pulses will still be needed but they can now be sent much less frequently, once every block rather than every byte. In the case of Teletext a block is conveniently taken as a row or line of text across the screen. A typical signal using this method can be seen in Fig. 2.

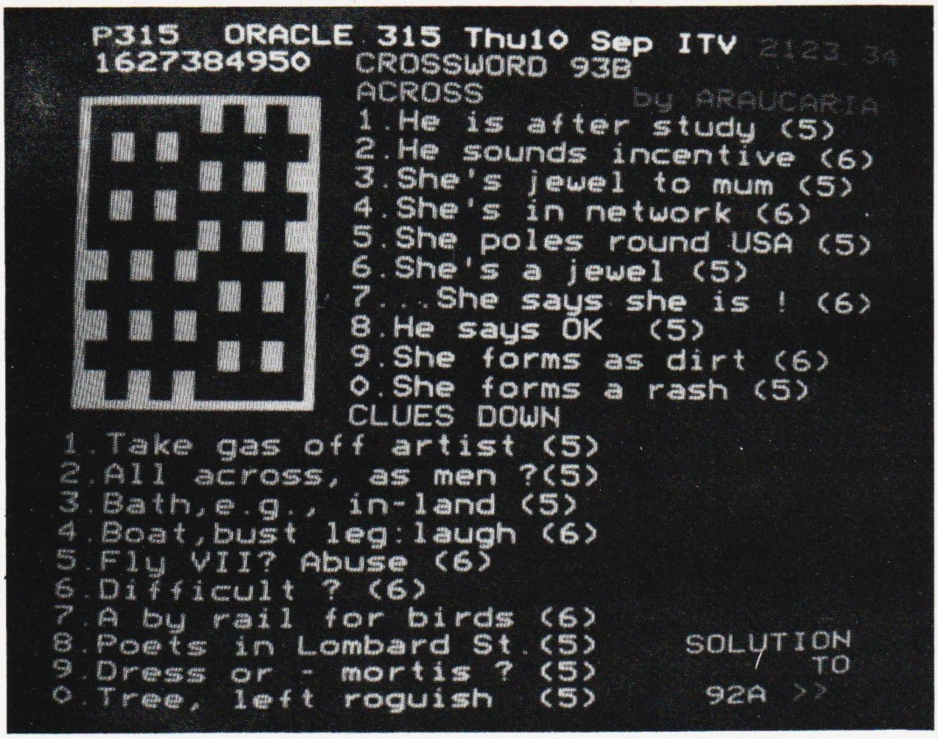
The byte overhead — that's the extra number of bytes per byte transmitted — is now three for synchronisation and two for address, five extra per row. This compares with a minimum of three extra bits per byte under the other system, a total of 15 extra bytes per row *excluding* the address.

Having got a serial bit stream to the TV set it can be decoded to produce textual and graphic information. However, as previously mentioned, Teletext works on pages. How are these identified? Each page in the magazine is given a unique number which can be dialled up on the set's remote control keypad. This number appears in the top left-hand corner of the screen, next to the set of scrolling digits which indicate the frame currently being transmitted.

Because the magazine is effectively a rotating drum, rather like a carousel-type slide magazine on a projector, it will take a finite time to collect any one page. To speed up the access to key frames, such as indexes, these are inserted more regularly into the magazines.

When the selected page code matches the header of the page currently being transmitted, the data is captured and displyed. OK, you say, there must be more to it than that. Well, you're dead right — there is. The only trouble is that it would take the whole of this, and the next, issue to explain it. I've put some references at the end for those hungry for information to read if they wish.

While text transmissions are second nature to the dedicated computerist, graphics may not be quite so readily understood. Basically each character cell, the area into which a character will fit, can be sub-divided into six pixels (see Fig. 3). Any combinations of these can be set to on or off and displayed in any of the available eight colours. Because a character needs some space to prevent it running into its neighbour, this type of graphic is described as non-contiguous — they don't join up. To create a continuous streak of colour one needs contiguous graphics and the difference can be clearly seen in the accompanying photographs. The transmission codes for all these extra, non-standard characters are given in Fig. 4.



Would you believe, a crossword! Press REVEAL and all is...

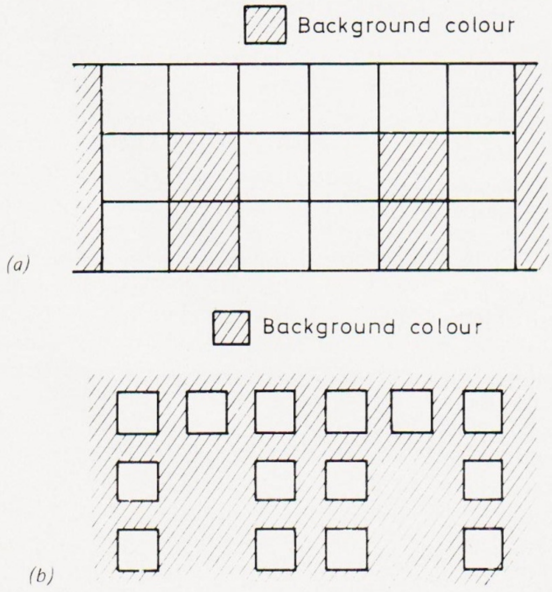
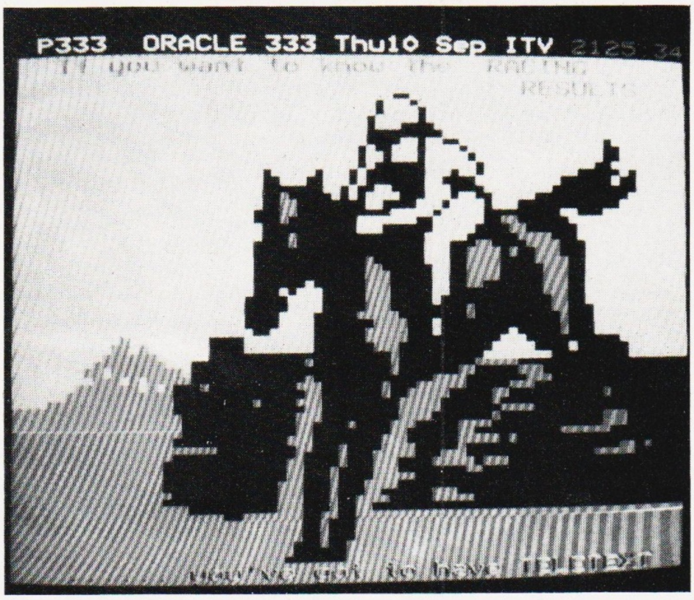
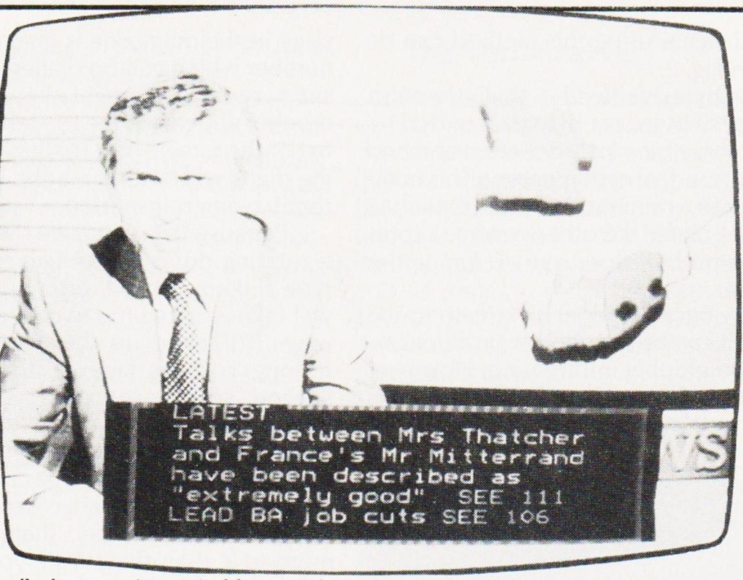


Fig. 3. The difference between contiguous (a) and separated (b) graphics blocks.



An example of the sort of graphics one can obtain even with a limited resolution system such as this.



A BBC Newsflash appearing, suitably enough, in the middle of the News! Subtitles appear in much the same way.

What's On TV?

You can get an awful lot from the Oracle and Ceefax pages if you know where to look. Indeed, the information service is so good that bookmakers, among others, use it to get results of races from rather than pay people to sit at the smaller racecourses and pop small fortunes into telephone booths. The apocryphal story is often told of the time when industrial action struck and the smitten company's switchboard started to glow under the pressure of irate bookies trying to find out whether they were going to pay out or not!

One of the most social of the offerings is the subtitling service provided by both the IBA and BBC. There are two types, one is a prepared, shortened form of the speech — rather like that used on the weekly News Review on BBC — and the second is a phonetic representation of the speech which is done in 'real-time'.

This service, together with the automatic updating of the newsflashes, are both displayed in boxes inlaid in the main TV picture. In the case of the news flash service one can read it, press UPDATE and it will disappear until a new item is put into the system. You then get the new item immediately. October has been set aside for promotion of Teletext, both by IBA and BBC, with the Government giving it a hefty push just before the IT year starts. This push does have another interesting aspect to it which the TV companies will undoubtedly use to their advantage. Many of the sets currently in use are reaching their last legs, certainly those old-style colour ones, and people looking for a new set may well be tempted to buy one with all the trimmings of remote control and Teletext.

How Can I Get It?

If you can't afford a new TV or have just bought one without Teletext, the only answer is an adaptor. These typically cost around £200 if you buy them commercially or you could have a go at building one of the kits, like that recently featured in the magazine Electronics Today International.

Sets with Teletext built in are becoming more readily available now with Philips, Sony, Ferguson and ITT all bringing new ones into the market. The additional price of the adaptor is dropping year by year: Thorn estimates that it is now £90 per 22" set compared with £165 last year and £191 in 1979. Philips, who are very active in this area, reckon that the market has increased by 250% over last year so one can only hope that the prices will continue to fall.

What The Future Holds

When the original specification was written it was realised that expansion of the service would need more lines unless people were prepared to wait minutes for information rather than seconds. That original specification allows for up to eight lines, and the BBC are currently testing on 15 and 16 in addition to the regular service on 17 and 18 together with in-house trials on 21. The IBA have already tested 13, 14, 15, 16 and 21 and are understood to have submitted a request to the Home Office for use of lines 16 and 21.

One of the biggest possibilities for the future is the prospect of Telesoftware. This is the transmission of computer programs and allied information over the Videotext system. Trials have been held by the IBA and BBC in conjunction with Brighton Polytechnic and, indeed, the soon-to-arrive BBC micro will have the expansion capability of a Teletext adaptor for just this purpose.

In fact the connection of any computer system to a Teletext receiver allows you to process that information. You could, for example, prepare instant news sheets, check the Stock Exchange prices automatically and do a host of other things given the right piece of hardwar. Getting a few computer programs free is icing on the cake!

A Final Byte

The future of Teletext as an information source in the UK is assured beyond doubt. The extent to which it will grow is probably only governed by the amount of room that is made available to it on the transmission system and the funds that the BBC and IBA have to spend. I can see that at some point in the future we may well have Channel 5 which is solely dedicated to carrying textual information. Allowing even as few as 200 lines for text that represents an enormous data base, the access would be a trifle slower than the best currently available — 20 seconds or so — but it would have the advantage of being free. I outlined a similar idea in a publication called ETI 1999 which was published a year or so ago.

The use of the broadcast medium has, in fact, only one major restriction and that is the fact that it is a one-way service. This statement is, of course, dependent on the fact that the number of lines available for transmission are increased in direct proportion to the size of the data base!

The next hurdle to be jumped in the development of the system is the creation of pictures. This has already been demonstrated, both on Teletext and Viewdata, but currently requires a substantial change in the design of the receivers. However, by the end of the 1980's we should have both this and fully operational Telesoftware services.

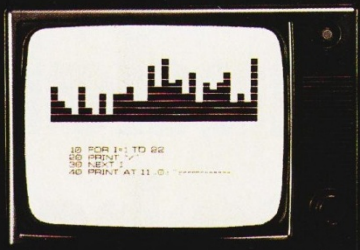
Next month I'll be featuring the same sort of information on the Viewdata service — so tune in again then!

Getting More Data

Suprisingly, the amount of published information on Teletext appears to be remarkably limited. Apart from technical documents produced by the IBA and the BBC the only book that I have is 'Teletext and Viewdata', by Steve A Money. Published by Newnes Technical Books, it goes into great detail about the techincal aspects of Teletext and, to a more limited degree, Viewdata. Most of the diagrams accompanying this article have been taken, with kind permission of the publishers, from this book.

For information on the Telesoftware experiment contact Brighton Polytechnic, Telesoftware and Education Project, Faculty of Education Studies, Falmer, Brighton, Sussex.

sinclair ZX81 PERSONAL COMPUTER



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

Kit: £49.95

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

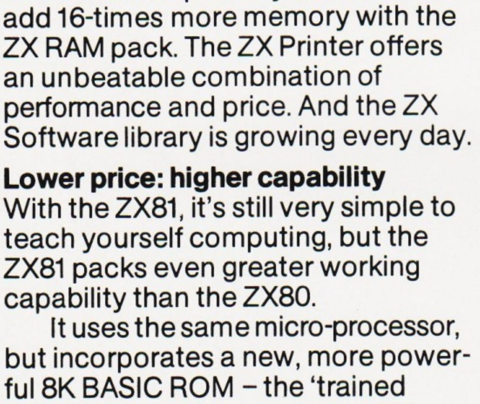
In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

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

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

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

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



New BASIC manual

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

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

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

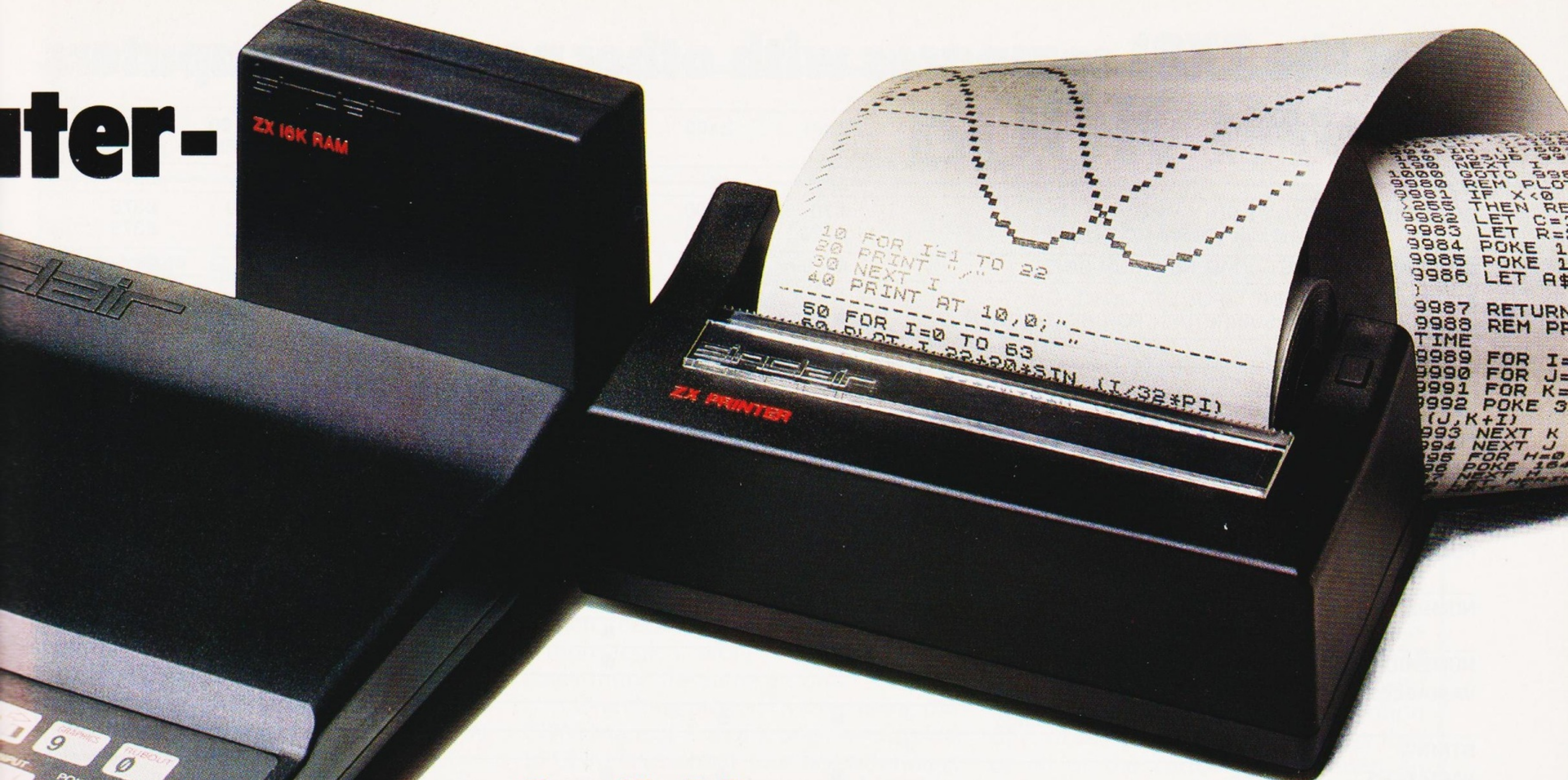
New, improved specification
- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique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

Built: £69.95

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

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

ter-



Available now- the ZX Printer for only £49.95

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

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

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

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

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

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

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

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

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

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

How to order your ZX81

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

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

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

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

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

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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 FUNCTIONS	ABS, RND	●	●	●	●	●	●	●
	INT	●			●	●	●	●
	ATN, COS, EXP, LOG, SGN, SIN, SQR, TAN	●			●	●		●
	ARCSIN, ARCOS	●						
STRING FUNCTIONS	CHR$	●	●		●	●		●
	LEN	●		●	●	●		●
	ASC(CODE), STR$, VAL, INKEY$	●				●		●
NUMBERS	FLOATING PT $\pm 10^{\pm 38}$	●			●	●	●	●
	INTEGERS		●	●	●	●		●
NUMERIC VARIABLES	A-Z			●			●	
	AA-ZØ				●	●		●
	An-Zn, n=any alphanumeric string	●	●					
STRING VARIABLES	A$ & B$						●	
	A$ to Z$	●	●	●				
	An$ to Zn$ n=any alphanumeric character				●	●		●
NUMERIC ARRAYS	SINGLE DIMENSIONAL		●	●			●	
	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 FEATURES	USR (CALL, LINK)	●	●	●	●	●		●
	PEEK, POKE (OR EQUIV)	●	●	●	●	●		●

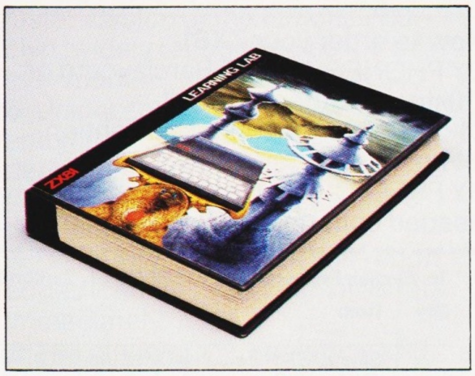
Sinclair software on cassette.

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

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

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

The ultimate course in ZX81 BASIC programming.



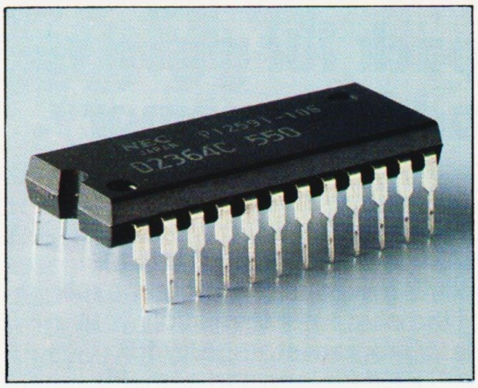
Some people prefer to learn their programming from books. For them, the ZX81 BASIC manual is ideal.

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

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

Full details with your Sinclair ZX81.

If you own a Sinclair ZX80...



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

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

sinclair
ZX81

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Tel: (0276) 66104 & 21282.

Mike James

Some standard texts on a standard DOS

One of the most used disc operating systems (DOS) is CP/M. It was introduced in the distant days of 1975 and it comes as something of a shock to realise that the earliest of the CP/M books reviewed here bears the date 1980. Why it has taken so long for the usual 'guide to' books to appear is something of a mystery, but suddenly they are here.

Any books on CP/M must be compared with the manuals supplied with CP/M. Thus our review begins with the **CP/M Manual** by Digital Research. It is difficult to believe that a manual which accompanies a very successful piece of software and which has been in circulation, in one form or another, since 1976, can be so poor. Digital Research seem to have made very little effort to make their first attempt at a manual at all accessible to the beginner and have avoided the opportunity for improvement with each version of CP/M. Even the milestone of version 2 prompted only the addition of two new sections to the manual describing the new bits of CP/M 2.0, most of which appear in entirely the wrong order! The rest of the manual is full of unnecessary obscurity and makes very difficult reading. However, given all these criticisms, it remains all that is necessary for the experienced machine code programmer but it is still difficult going even from that elevated point of view.

The next book is from another well known personality of the computer publishing world, Rodnay Zaks — boss of Sybex. **The CP/M Handbook With MP/M** is, unlike Osborne's book, by Zaks himself. Chapter 1 starts at the usual point with a review of CP/M and its history, then moves on to tell the user how to get his computer up and running CP/M. Some of the more basic commands are introduced and explained, eg DIR, REN. By the end of chapter 1 the novice user should be able to cope with creating a file using ED and printing it. Chapter 2 covers the remaining commands up to ASM and DDT. Chapter 3 is devoted entirely to PIP and it explains this difficult program very well. The CP/M editor, ED, is also covered by the whole of chapter 4. Chapter 5 is 'Inside CP/M and MP/M', although you'll find nothing that isn't in the CP/M manual. A useful CP/M - MP/M command summary finishes the book. With one instruction to a page, in alphabetical order, this is very easy to use. Zaks' book is, in my opinion, more suitable for beginners than Hogan's because it treats the material in a more logical order — but they both cover much the same ground.

One thing proved by examining the CP/M Manual is that a beginners' guide to CP/M is essential. Our first offering is the **Osborne CP/M User Guide**. The name of Adam Osborne has been well known since the start of microcomputing for a wide range of books and educational material. Now McGraw-Hill have taken over Osborne publishing, it will be interesting to see how much things change. It is clear that they plan to use the name Osborne as a catch word for quality, because the Osborne CP/M User Guide is, in fact, written by Thom Hogan! It starts off at a reasonable pace with an introduction and history of CP/M, and goes on to tell the novice user how to start his computer up into CP/M (something the machine's manual should explain, but . . .). Chapter 2 deals with the standard built-in commands and chapter 3 deals with the standard transient commands. Both chapters cover their material well with examples and patient explanation. As the introduction covers all the CP/M commands, the novice computer user, who has just been so well treated in chapter 1, meets commands such as SAVE and DUMP better reserved for experienced machine code programmers. It would be better to treat commands as they are required and then give a complete summary. By chapter 4 the book shows its true colours. We are well into assembly language utilities, and the ASM, DDT and LOAD are explained. The trouble is that anyone capable of using such utilities can probably do without the extra help afforded by this book. The remainder of the book covers high level languages, MP/M, CP/NET and technical aspects of CP/M among other things. In conclusion, this is not a book for a beginner unless he wants to approach the more technical side of computing. It is well written and contains some useful extra pieces of information concerning system and high level language selection.

The final book this month, **CP/M Primer**, comes from yet another well known technical publisher — Sams. The first thing that strikes you about this book is its size. Being roughly A4, more information appears on each page than the previous books reviewed and this is used to advantage in explaining CP/M with tables, figures, cartoons and boxed extra bits of information. If the mention of cartoons puts you off, let me say that of all of the cartoon-laden American technical comics that I've looked at this book is the only one to use cartoons to add to the text. They may not be very funny — I smiled rather than laughed — but most of the cartoons illustrate some difficult concepts very well. The explanations are chatty but still well written and I must admit that I did enjoy reading this book. Chapter 1 is an introduction to CP/M, chapter 2 introduces computer systems in general, chapter 3 is about getting started and resident commands, chapter 4 is system initialisation, 5 covers STAT and PIP, 6 is ED, 7 and 8 are about machine code programming, ASM and DDT. There are also three appendices and one is a pull-out CP/M reference card — really useful as long as you remember where you put it! Appendix A covers the internal structure of CP/M and unlike the other two books, succeeds in telling you something extra to the CP/M Manual, not much but something! One reason I liked this book so much is that the two authors seem to be still interested in microcomputers and succeed in communicating their enthusiasm for understanding the 'black boxes'. I would recommend it to anyone interested in computers rather than in simply using them.

The titles included in this month's selection are:

CP/M Manual, by Digital Research, obtainable from Lifeboat Associates (1979), £15.

The CP/M Handbook With MP/M, by Rodnay Zaks, published by Sybex, distributed by Computer Bookshop (1980), 321 pages, £9.50.

Osborne CP/M User Guide, by Thom Hogan, published by McGraw-Hill (1981), 280 pages, £10.10.

CP/M Primer, by Stephen M Murtha and Mitchell Waite, published by Sams, distributed by Prentice-Hall (1980), 92 pages, £7.75.

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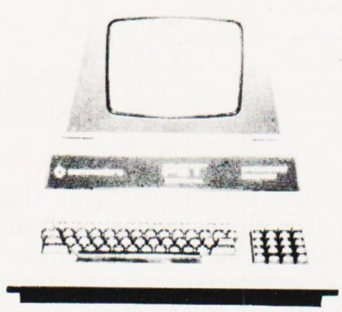

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For the business man we stock the **8000** range inc **8032** and **8050** with daisy wheel printers coming soon.

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VIC 20

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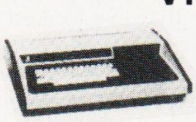

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Utilises Z80, 12K level II Basic, Integral Cassette Deck, UHF O/P, 16K RAM, all TRS80 features. Simply plugs into monitor or UHF TV. With V.U. Meter.

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COLOUR KIT (FITTING EXTRA)	£34.95
EXPANSION BOX WITH/WITHOUT RS232	£215/£185
16K/32K RAM BOARD	£94/£129
NEW GENIE II NOW AVAILABLE	£299

VIC 20

Colours
24 total. 8 for characters, 8 for border, 16 for screen mixed as you wish. Basic colours on program keys are black, white, red, blue, light blue, green, yellow and purple.

Sound
3 Tone Generator for music, "White Noise" Generator for language and sound effects. Each Generator gives 3 octaves. Reproduction is through TV speaker.

Character/Line Display
22 Characters by 23 lines, 64 ASCII characters, pet-type graphic character set.

Keyboard
DIN typewriter keyboard with 8 programmable function possibilities via 4 special function keys. Colours are directly addressable from the keyboard.

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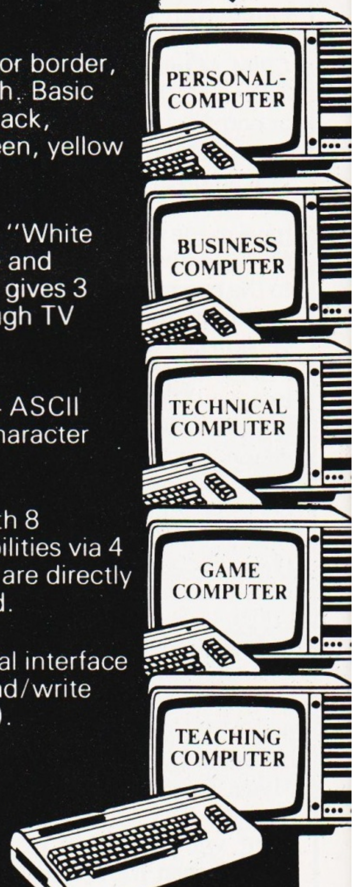

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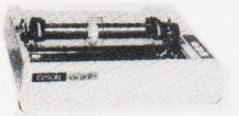

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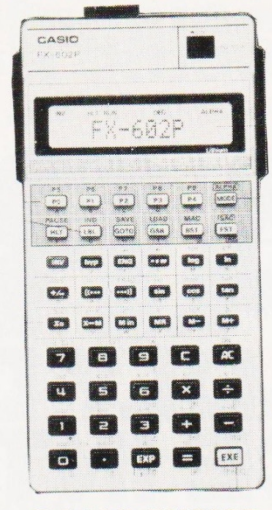

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This RAM pack and the replacement ROM are described below. And the description of each cassette makes it clear what hardware is required.

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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	25	Cassette 5 – Junior Education	£3.95	
	17	*8K BASIC ROM for ZX80	£19.95	
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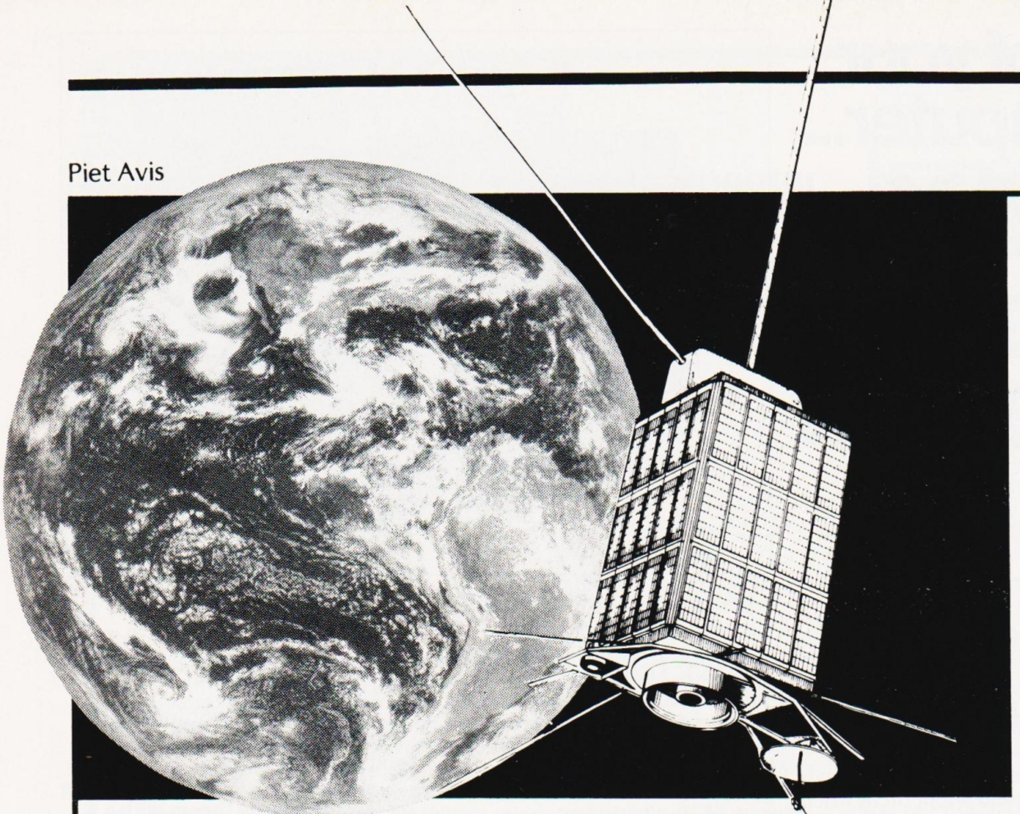

From the Big Bang to Milliways in minutes

The program displays a moving picture which looks something like the night sky. There is a star-field and in front is a central sun with planets and their satellites. A comet appears and takes a slow elliptical orbit, speeding up as it goes round the sun. There is an occasional meteor flash. Now and then a star flares into a supernova and declines slowly, and (with a probability which can be set to agree with one's beliefs) a civilisation escapes the supernova and settles on another star. There is interstellar commerce and a space-trading UFO moves from one star to another. The fate of the universe is under human control; a probability is set and if the right number comes up the universe contracts to a singularity. The point does not disappear (where would it go?) and after a time it expands again into a new and slightly different universe. The program loops through one universe after another without end, on the assumption that time in the real universe will not stop, not for a while anyway. The display is best seen in a darkened room on a large television screen with brilliance down and contrast up. A transistor radio placed near the CPU will pick up the Music of the Spheres.

Spacing Out

The program is in BASIC for a NASCOM 2 and requires less than 8K of RAM if the spaces in the program listing are omitted. A problem in some BASIC programs is to find out exactly how POKEs and PEEKs can be translated to a different machine, and this program deliberately avoids them. SET and RESET or similar functions are required, and are used on the 48 by 96 NASCOM grid; a little coarse for moving heavenly bodies about, but acceptable. The program also uses the 16 by 48 character grid for some astronomical objects. The result of all this is full-stop stars and square planets. However the orbits are as nearly round or elliptical as possible (square orbits were ruled out as beyond current experience). It is not, of course, a true simulation — for one thing the time scale is all wrong — but some mathematical relationships have been retained.

Program Operation

The program contains examples of loop control and subroutines and uses a mixture of the two types of screen co-ordinate. It is made up of a number of independent parts which operate in sequence, and it can be built up section by section. It might be used as a teaching aid.

A problem is that the passage of an object over the screen wipes out everything in its path, including planets and central sun even though these are supposed to be in the foreground. It is possible to program in position tests, using either the POINT function or logic tests on the screen map in memory. However the amount of programming necessary to accomodate every feature on the screen is large and the program compromises by re-displaying the star background and central sun and planets as quickly as possible after a passage. The elliptical cometary orbit is not renewed and can look quite tatty after many time periods.

The initial values may be altered. The planetary radii and orbital periods may be altered to suit one's favourite system. Note that reversing the sign of an orbital period reverses the direction of rotation. The probabilities P1 to P5 may be experimented with to give a soothing display, if that is what is wanted. Probabilities greater than about 0.5 get things moving, with the generation of a new universe every few time periods. The display resulting from the program as printed is a little rapid; BASIC is slow, but the universe is in no hurry and an all-night display can be set up by the strategic insertion of some delay loops.

Features might be added; for example the stars can be made to twinkle by quick random applications of RESET and SET. At the end of the universe the stars converge to a singularity; they could be made to expand from it at the start of a new universe in an orderly fashion instead of the symbolic Big Bang. The star co-ordinates could be set to resemble real constellations as we see them. An invisible wandering black hole might swallow up stars and any other body it came across, although this does not make a spectacular display.

Program Description

Lines 150 — 320: DIMensioning and initialisation of run parameters. The values are at the start of the program to allow easy alteration using the NASCOM screen editing facilities. The entry point of a new universe is at line 200. The variables are:

A(12),B(12): co-ordinates of the planets and satellites. Array A contains current values; B contains previous values for RESETing.

R(6),N(6): radii and orbital periods of the six planets and satellites. Array N is used later to hold equivalent periodic angular changes in the orbits.

T(12): sines and cosines of the periodic angular changes for use in trigonometrical formulas.

G(30),H(30),GP(30),HP(30): co-ordinates of the background stars. Arrays GP and HP hold the previous values during collapse.

P1: probability of collapse of the universe.

P2: probability of observing a UFO flight.

P3: probability of a supernova

P4: probability that a spaceship will escape before a supernova.

P5: probability of a meteor.

D,E,F,KE: comet data. D is the distance of nearest approach to the central body; E is the eccentricity; F is the orbital period; KE is the angle in radians of the major axis of the comet's orbit to the screen horizontal.

Lines 330 — 490: working values are calculated from the starting data. The array A is provided with starting co-ordinates for the six planets and satellites.

Lines 500 — 630: display the background of 31 stars, avoiding positions too near the central body. The central body is displayed.

Lines 640 — 700: working values for the cometary orbit.

Lines 710 — 770: these complete the preliminary calculations. The entry point to a new time period is line 740. The period number is incremented and printed.

Lines 780 — 1460: calculate and display planet and satellite positions. Nine sets are required as the satellites are moved twice; once about the central sun and again about their parent bodies.

Lines 1470 — 1610: update the orbit of the comet; check for meteor, supernova, UFO and collapse of the universe.

Line 1630: return to line 740 and repeat the cycle for the next time period.

Lines 1640 — 1810: subroutine to update and display the comet's orbit. The orbit is Keplerian as long as the orbital period (variable F) is not too short, say not less than 200 time periods.

Lines 1820 — 1890: subroutine to calculate new positions of planets and satellites in circular orbits, using trigonometrical formulas for sums of angles.

Lines 1900 — 1990: subroutine to display a meteor running vertically down the screen.

Lines 2000 — 2170: subroutine to move a body to a new position, using SET and RESET functions. The body may be a 1 x 1 or a 2 x 2 block, it may leave a trail.

Lines 2180 — 2720: subroutine to develop a supernova as a block of graphic points from an existing star. The supernova flares up immediately and declines over several time periods. A graphic dot to represent a spaceship is moved from the supernova star to another using the subroutine at line 2780.

Lines 2730 — 2770: subroutine to display the central sun. It uses a graphic dot (NASCOM GR/9), two vertical lines (GN/CNTRL/T) and two ordinary dashes. (Owing to a well-known bug the graphics are LISTed as USR and DEF). There should be suitable symbols on other machines.

Lines 2780 — 3080: subroutine to move a dot from one co-ordinate position to another using SET and RESET. The dot moves over the 48 x 96 grid in the nearest it can get to a straight line.

Lines 3090 — 3500: a program section to move the star points inwards to a central point represented by the graphic GR/9. After a delay loop a mass of graphic blocks is displayed to symbolise an exploding universe. The program then goes back to a new start at line 200.

Program Listing

```
150 REM - INITIALIZE DATA
160 DIM A(12),B(12),R(6),T(12),N(6)
170 DIM G(30),H(30),GP(30),HP(30)
180 REM - START A NEW UNIVERSE
190 XB = 24 : YB = 8 : GOTO 3320
200 NS = 0
210 XB = INT(RND(1) * 25) + 20
220 YB = INT(RND(1) * 10) + 25
230 FA = INT(XB/2) + 1 :
    FB = INT(YB/3) + 1
240 R(1) = 11 : R(2) = 26 : R(3) = 43
250 R(4) = 5 : R(5) = 5 : R(6) = 4
260 N(1) = -157 : N(2) = 365.25
270 N(3) = 680 : N(4) = 12
280 N(5) = 8 : N(6) = -40
290 P1 = .008 : P2 = .1
300 P3 = .05 : P4 = .6 : P5 = .05
310 D = 5 : E = .75
320 F = 200 : KC = 2.3
330 REM - CALCULATE WORKING VALUES
340 PD = 6.283185 : PQ = PD/4
350 FOR J= 1 TO 6 : N(J) = PD/N(J)
360 NEXT J
370 NP = 0
380 FOR J = 1 TO 6 : NP = NP + 1
390 T(NP) = SIN(N(J))
400 NP = NP + 1
410 T(NP) = SIN(N(J) + PQ)
420 NEXTJ
430 A(1) = XB + R(1) : A(2) = YB
440 A(3) = XB + R(2) : A(4) = YB
450 A(5) = XB + R(3) : A(6) = YB
460 A(7) = A(3) + R(4) : A(8) = YB
470 A(9) = A(5) + R(5) : A(10) = YB
480 A(11) = A(5) + R(6) : A(12) = YB
490 X7 = A(3) : Y7 = A(4) : CLS
500 REM - SET STAR BACKGROUND
510 SCREEN 5,1 : PRINT "- star formation -"
520 FOR J = 0 TO 30
530 NG = INT(RND(1) * 43) + 3
540 NH = INT(RND(1) * 12) + 2
550 IF NG < FA - 3 OR NG > FA + 3 THEN 580
560 IF NH < FB - 3 OR NH > FB + 3 THEN 580
570 GOTO 530
580 G(J) = NG : H(J) = NH
590 SCREEN NG,NH : PRINT "."
600 FOR Z = 1 TO 2000 / (J + 1) : NEXT Z
610 NEXT J
620 SCREEN 5,1 : PRINT "                                    "
630 GOSUB 2730
640 REM - WORKING VALUES FOR COMET
650 CE = 1 : SE = 0
660 EP = 1 + E : EM = 1 - E
670 L = D * EP
680 TA = D / EM : TB = TA * SQR(EP * EM)
690 F = (4 * PQ * TB / F) * TA
700 KS = SIN(KC) : KC = SIN(KC + PQ)
710 REM - START INFINITE LOOP
720 SCREEN 5,1 : PRINT "planetary system -"
730 ND = 0
740 REM - NEXT TIME PERIOD
750 ND = ND + 1
760 SCREEN 39,1 : PRINT ND
770 REM - CALCULATE COORDS OF PLANETS
780 NP = 0
790 FOR J = 1 TO 3
800 NP = NP + 1
810 XN = A(NP) : SB = T(NP)
820 NP = NP + 1
830 YN = A(NP) : CB = T(NP)
840 XC = XB : YC = YB : RD = R(J)
850 GOSUB 1820
860 A(NP - 1) = XN : A(NP) = YN
870 XA = XN : YA = YN
880 XP = B(NP - 1) : YP = B(NP)
890 NI = 1
900 GOSUB 2000
910 B(NP - 1) = XP : B(NP) = YP
920 NEXT J
930 XN = A(7) : SB = T(3)
```

```
940 YN = A(8) : CB = T(4)
950 XC = XB : YC = YB
960 XT = XN - XC : YT = YN - YC
970 RD = SQR(XT * XT + YT * YT)
980 GOSUB 1820
990 A(7) = XN : A(8) = YN
1000 XN = A(9) : SB = T(5)
1010 YN = A(10) : CB = T(6)
1020 XC = XB : YC = YB
1030 XT = XN - XC : YT = YN - YC
1040 RD = SQR(XT * XT + YT * YT)
1050 GOSUB 1820
1060 A(9) = XN : A(10) = YN
1070 XN = A(11) : SB = T(5)
1080 YN = A(12) : CB = T(6)
1090 XC = XB : YC = YB
1100 XT = XN - XC : YT = YN - YC
1110 RD = SQR(XT * XT + YT * YT)
1120 GOSUB 1820
1130 A(11) = XN : A(12) = YN
1140 XN = A(7) : SB = T(7)
1150 YN = A(8) : CB = T(8)
1160 XC = A(3) : YC = A(4)
1170 RD = R(4)
1180 GOSUB 1820
1190 A(7) = XN : A(8) = YN
1200 XA = XN : YA = YN
1210 XP = B(7) : YP = B(8)
1220 NI = 0
1230 GOSUB 2000
1240 B(7) = XP : B(8) = YP
1250 XN = A(9) : SB = T(9)
1260 YN = A(10) : CB = T(10)
1270 XC = A(5) : YC = A(6)
1280 RD = R(5)
1290 GOSUB 1820
1300 A(9) = XN : A(10) = YN
1310 XA = XN : YA = YN
1320 XP = B(9) : YP = B(10)
1330 NI = 0
1340 GOSUB 2000
1350 B(9) = XP : B(10) = YP
1360 XN = A(11) : SB = T(11)
1370 YN = A(12) : CB = T(12)
1380 XC = A(5) : YC = A(6)
1390 RD = R(6)
1400 GOSUB 1820
1410 A(11) = XN : A(12) = YN
1420 XA = XN : YA = YN
1430 XP = B(11) : YP = B(12)
1440 NI = 0
1450 GOSUB 2000
1460 B(11) = XP : B(12) = YP
1470 REM - UPDATE COMET; CHECK EVENTS
1480 SCREEN 5,1 : PRINT"          "
1490 GOSUB 1640
1500 IF RND(1) < P5 THEN GOSUB 1900
1510 GOSUB 2180
1520 IF RND(1) < P1 THEN 3090
1530 IF RND(1) > P2 OR NS > 0 THEN 1620
1540 X1 = X7 : Y1 = Y7
1550 NW = INT(RND(1) * 31)
1560 IF NW = MS THEN 1550
1570 X2 = G(NW) * 2 - 2 : X7 = X2
1580 Y2 = H(NW) * 3 - 2 : Y7 = Y2
1590 SCREEN 20,1 : PRINT "ufo - ufo"
1600 GOSUB 2780: SET(X2,Y2)
1610 SCREEN 20,1 : PRINT "         "
1620 REM - GO TO NEXT TIME PERIOD
1630 GOTO 740
1640 REM - COMET CALCULATIONS
1650 V = L / (1 - E * CE)
1660 XA = V * CE : YA = V * SE
1670 XT = XA
1680 XA = XT * KC - YA * KS
1690 YA = YA * KC + XT * KS
1700 XA = XA + XB
1710 YA = YB - YA
1720 XP = XI : YP = YI
1730 NI = 2
1740 GOSUB 2000
1750 XI = XP : YI = YP
1760 REM
1770 TI = F / (V * V)
1780 TH = TH + TI
1790 SE = SIN(TH)
1800 CE = SIN(TH + PQ)
1810 RETURN
1820 REM - CALCULATE PLANET COORDS
1830 XT = XN - XC : YT = YC - YN
1840 SA = YT / RD : CA = XT / RD
1850 SN = SA * CB + CA * SB
1860 CN = CA * CB - SA * SB
1870 XN = RD * CN + XC
1880 YN = YC - RD * SN
1890 RETURN
1900 REM - DISPLAY A METEOR
1910 SCREEN 5,1 : PRINT "meteor -"
1920 X = INT(RND(1) * 95)
1930 FOR Y = 4 TO 44
1940 SET(X,Y) : RESET(X,Y - 1)
1950 NEXT Y
1960 RESET(X,43) : RESET(X,44)
1970 SCREEN 5,1 : PRINT "        "
1980 GOSUB 2730
1990 RETURN
2000 REM - MOVE A BODY TO NEW POSITION
2010 XA = INT(XA) + 1 : YA = INT(YA) + 1
2020 IF XA = XP AND YA = YP THEN 2170
2030 IF XP < 0 OR XP > 93 THEN 2100
2040 IF YP < 1 OR YP > 44 THEN 2100
2050 IF NI > 1 THEN 2100
2060 RESET(XP,YP)
2070 IF NI < 1 THEN 2100
2080 RESET(XP,YP - 1) :
     RESET(XP + 1,YP - 1)
2090 RESET(XP + 1,YP)
2100 IF XA < 0 OR XA > 93 THEN 2160
2110 IF YA < 1 OR YA > 44 THEN 2160
2120 SET(XA,YA)
2130 IF NI <> 1 THEN 2160
2140 SET(XA,YA - 1) : SET(XA + 1,YA - 1)
2150 SET(XA + 1,YA)
2160 XP = XA : YP = YA
2170 RETURN
2180 REM - CALCULATE AND DISPLAY SUPERNOVA
2190 IF NS > 0 THEN 2400
2200 IF RND(1) > P3 THEN 2720
2210 NS = 1 : NV = INT(RND(1) * 31)
2220 MS = NV
```

```
2230 NF = 0 : NZ = INT(RND(1) * 2) + 4
2240 NX = G(NV) * 2 - 1
2250 NY = H(NV) * 3 - 2
2260 KZ = 0 : SET(NX,NY)
2270 IF RND(1) > P4 THEN 2390
2280 NU = 1
2290 X1 = NX : Y1 = NY
2300 NW = INT(RND(1) * 31)
2310 IF NW = NV THEN 2300
2320 MW = NW
2330 X2 = G(NW) * 2 - 2 : Y2 =
     H(NW) * 3 - 2
2340 SCREEN 5,1
2350 PRINT "escape from supernova -"
2360 GOSUB 2780: NU = 0 : MW = 99
2370 SCREEN 5,1
2380 PRINT "                         "
2390 SCREEN 5,1:PRINT "supernova -"
2400 NF = NF + 1
2410 IF KZ >= NZ THEN 2540
2420 IF NF < 1 THEN 2720
2430 NF = 0 : KZ = KZ + 1
2440 Y3 = NY : Y4 = NY
2450 AV = NX - KZ + 1 : BV = NX + KZ - 1
2460 FOR X = AV TO BV
2470 SET(X,Y3) : SET(X,Y4)
2480 IF X < NX THEN 2510
2490 Y3 = Y3 + 1 : Y4 = Y4 - 1
2500 GOTO 2520
2510 Y3 = Y3 - 1 : Y4 = Y4 + 1
2520 NEXT X
2530 GOTO 2390
2540 NZ = NZ - 1
2550 SCREEN 5,1 : PRINT "              "
2560 NF = NF + 1
2570 IF NF < 2 THEN 2720
2580 NF = 0
2590 Y3 = NY : Y4 = NY
2600 AV = NX + KZ - 1 : BV = NX - KZ + 1
2610 FOR X = AV TO BV STEP -1
2620 RESET(X,Y3) : RESET(X,Y4)
2630 IF X > NX THEN 2660
2640 Y3 = Y3 - 1 : Y4 = Y4 + 1
2650 GOTO 2670
2660 Y3 = Y3 + 1 : Y4 = Y4 - 1
2670 NEXT X
2680 KZ = KZ - 1
2690 IF KZ > 0 THEN 2720
2700 NS = 0
2710 SCREEN G(NV),H(NV) : PRINT "."
2720 RETURN
2730 REM - DISPLAY CENTRAL BODY
2740 SCREEN FA,FB - 1 : PRINT "DEF"
2750 SCREEN FA - 1,FB : PRINT "-USR-"
2760 SCREEN FA,FB + 1 : PRINT "DEF"
2770 RETURN
2780 REM - ESCAPE - MOVE A POINT
2790 DX = X2 - X1 : DY = Y2 - Y1
2800 IF DX = 0 AND DY = 0 THEN RETURN
2810 IF ABS(DX) > ABS(DY) THEN 2850
2820 LA = Y1 : LB = Y2
2830 X = X1 : Y = Y1 : DC = 0
2840 GOTO 2880
2850 LA = X1 : LB = X2
2860 DC =DX :  DX = DY : DY = DC
2870 X = Y1 : Y = X1 : DC = 1
2880 IF DY = 0 THEN RETURN
2890 JB = X : KB = Y
2900 IC = DX / ABS(DY)
2910 X = X + .5 - IC
2920 SP = 1 : IF DY < 0 THEN SP = -1
2930 FOR KA = LA TO LB STEP SP
2940 X = X + IC : JA = INT(X)
2950 IF DC > 0 THEN 2980
2960 SET(JA,KA) : RESET(JB,KB)
2970 GOTO 2990
2980 SET(KA,JA) : RESET(KB,JB)
2990 JB = JA : KB = KA : SCREENG(NV),H(NV)
3000 PRINT"." : NEXT KA
3010 FOR J = 0 TO 30
3020 IF J = MW THEN 3060
3030 IF J = MS THEN 3060
3040 IF G(J) = XI AND H(J) = YI THEN 3060
3050 SCREEN G(J),H(J) : PRINT "."
3060 NEXT J
3070 GOSUB 2730
3080 RETURN
3090 REM - SHRINK THE UNIVERSE
3100 FOR J = 0 TO 30
3110 GP(J) = G(J) : HP(J) = H(J)
3120 NEXT J
3130 XB = 24 : YB = 8
3140 CLS
3150 SCREEN 5,1
3160 PRINT "collapsing universe -"
3170 FOR J = 0 TO 30
3180 SCREEN G(J),H(J) : PRINT "."
3190 NEXT J
3200 SCREEN XB,YB : PRINT "USR"
3210 FOR N = 10 TO 1 STEP -1
3220 FOR J = 0 TO 30
3230 GT = G(J) : G(J) = GT - (GT - XB) / N
3240 HT = H(J) : H(J) = HT - (HT - YB) / N
3250 GT = INT(GT + .5) : HT = INT(HT + .5)
3260 IF GP(J) = XB AND HP(J) = YB THEN 3300
3270 SCREEN GP(J),HP(J) : PRINT " "
3280 IF GT = XB AND HT = YB THEN 3300
3290 SCREEN GT,HT : PRINT "."
3300 GP(J) = GT : HP(J) = HT
3310 NEXT J, N
3320 CLS : SCREEN XB,YB : PRINT "USR"
3330 SCREEN 5,1:PRINT"the primaeval atom -"
3340 FOR Z = 1 TO 5000 : NEXT Z : CLS
3350 REM - BIG BANG
3360 FOR J = 1 TO 200
3370 XB = INT(J*((RND(1)*.45)-.225)+47.5)
3380 YB = INT(J*((RND(1)*.2)-.1)+22.5)
3390 SET(XB,YB - 1) : SET(XB - 1,YB + 1)
3400 SET(XB - 1,YB) : SET(XB + 1,YB - 1)
3410 SET(XB + 1,YB + 1) : SET(XB,YB)
3420 SET(XB + 1,YB) : SET(XB,YB + 1)
3430 SET(XB - 1,YB - 1)
3440 NEXT J
3450 SCREEN 2,8 : PRINT "                 "
3460 SCREEN 2,9 : PRINT " A new universe -"
3470 SCREEN 2,10: PRINT "                 "
3480 FOR Z = 1 TO 4000 : NEXT Z
3490 REM - GO TO NEXT UNIVERSE
3500 GOTO 200
3510 END
```

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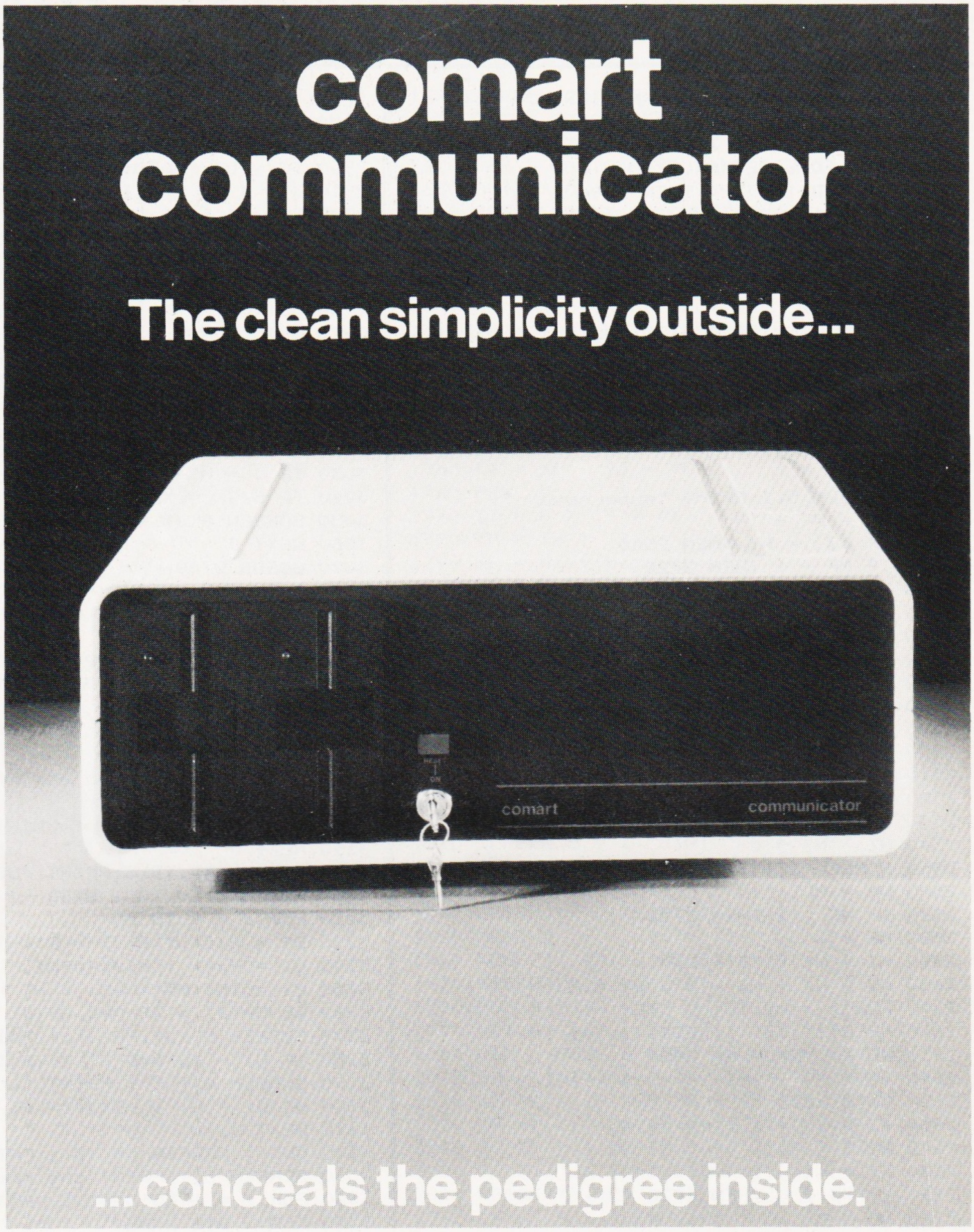

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GRAPHIC DETAILS

By popular demand we are repeating our Graphic Details series

Many currently available personal microcomputers are equipped with memory mapped screens and graphics character sets. These facilities allow the user to produce pictorial and graphic displays, (the resolution generally being somewhat crude) and play all those interesting games. But, what if you want to translate a program written for another machine which uses another graphics set and has a different screen memory area? Up till now this has been a difficult task and its success has tended to depend on the quality of the documentation supplied with the published software.

Now, if you had a series of charts showing all the standard codes and screen positions, you could look up on the appropriate one, cross reference to your machine and select the correct graphic and its code. Here we give a selection of graphics sets belonging to some of the more popular machines along with a variety of useful notes. But before we dive in, it is necessary to explain where they all came from.

The ASCII Set

The standard character code set for computers is known as ASCII, the acronym for American Standard Code for Information Interchange.

It is based around a seven bit natural binary sequence thus providing a total of 127 different alphanumeric and control codes. Although $2^8 = 128$ we usually regard 'all zeroes' and 'all ones' as NULL codes hence the figure of 127 unique codes. In many systems an eight bit code is used with the extra bit functioning as a parity check.

The first table gives the complete ASCII character set but it is important to bear in mind that this and all the subsequent tables are printed as they would be written on paper, (black on white) whereas the VDU displays everything in white on black: so you must mentally reverse everything in order to 'see' what it looks like on the screen.

The ASCII codes from 1 to 32 have special control functions. The ones of most use to the general programmer are as follows; 7-Bell, 10-Line feed, 12-Form feed (can be used as a Clear screen), 13-Carriage return, 32-Space. On some machines, notably those of US origin, code 35 will be a #(hash) symbol.

Character Codes

All the alphagraphic code sets are similar in a number of ways to the ASCII set in that their alphanumeric codes follow the same sort of pattern, code E being a number four greater than code A for example. In general the first 31 codes are used for graphics as are the extra 127 codes not used by the ASCII set. It should be noted at this point that these numbers are *not* replacements for the ASCII code but numbers to be used in conjunction with the BASIC PEEK and POKE commands which access a referenced location in memory. If you wish to use the ASCII set then the BASIC function CHR($) should be used, for example PRINT CHR$ (12) clears the screen by using the appropriate ASCII control code, whereas POKEing code 12 would output the respective graphic character. This apparent quirk is a trap for the unwary but a little practice soon prevents the silly mistakes.

Standard Codes

One of the commonly asked questions is 'how can we give the cursor movements?' The answer is simple, you use the standard set of character codes that CT has developed. These are as shown in Table 1.

CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL
0	NUL	32	SP	64	@	96	
1	SOH	33	!	65	A	97	a
2	STX	34	"	66	B	98	b
3	EXT	35	£	67	C	99	c
4	EOT	36	$	68	D	100	d
5	ENQ	37	%	69	E	101	e
6	ACK	38	&	70	F	102	f
7	BEL	39	'	71	G	103	g
8	BS	40	(	72	H	104	h
9	HT	41	)	73	I	105	i
10	LF	42	*	74	J	106	j
11	VT	43	+	75	K	107	k
12	FF	44	,	76	L	108	l
13	CR	45	–	77	M	109	m
14	SO	46	.	78	N	110	n
15	SI	47	/	79	O	111	o
16	DLE	48	0	80	P	112	p
17	DC1	49	1	81	Q	113	q
18	DC2	50	2	82	R	114	r
19	DC3	51	3	83	S	115	s
20	DC4	52	4	84	T	116	t
21	NAK	53	5	85	U	117	u
22	SYN	54	6	86	V	118	v
23	ETB	55	7	87	W	119	w
24	CAN	56	8	88	X	120	x
25	EM	57	9	89	Y	121	y
26	SUB	58	:	90	Z	122	z
27	ESC	59	;	91	[	123	{
28	FS	60	<	92	\	124	¦
29	GS	61	=	93	]	125	}
30	RS	62	>	94	↑	126	~
31	US	63	?	95	←	127	DEL

The ASCII code set. Codes 0 to 31 are non-printing and are used to control external devices.

To indicate that these are not part of the computer program we always enclose them in square brackets, most systems will generate a Syntax Error if you try to run a program without converting them into something more sensible. This idea has been expanded to include graphics as well, simply because many people don't possess printers that can draw them.

To indicate the appropriate graphics character for a machine such as the Sharp MZ-80K the following procedure is used. Each key is fitted with a graphic legend that corresponds to the graphic that will be produced when that key is pressed in the 'graphics' mode. The 'heart' symbol for example is on the 'S' key. To indicate that you want the heart you write it as [↑ S].

With both the graphics and the cursor codes you can indicate multiple entries by inserting a number, [12 CD] would mean 'twelve Cursor Downs'. If you wish to clarify the graphics by means of a REM statement do make it clear which lines you are referring to, an even better method is to use a short table at the beginning of the program, or as part of the description.

Footnote

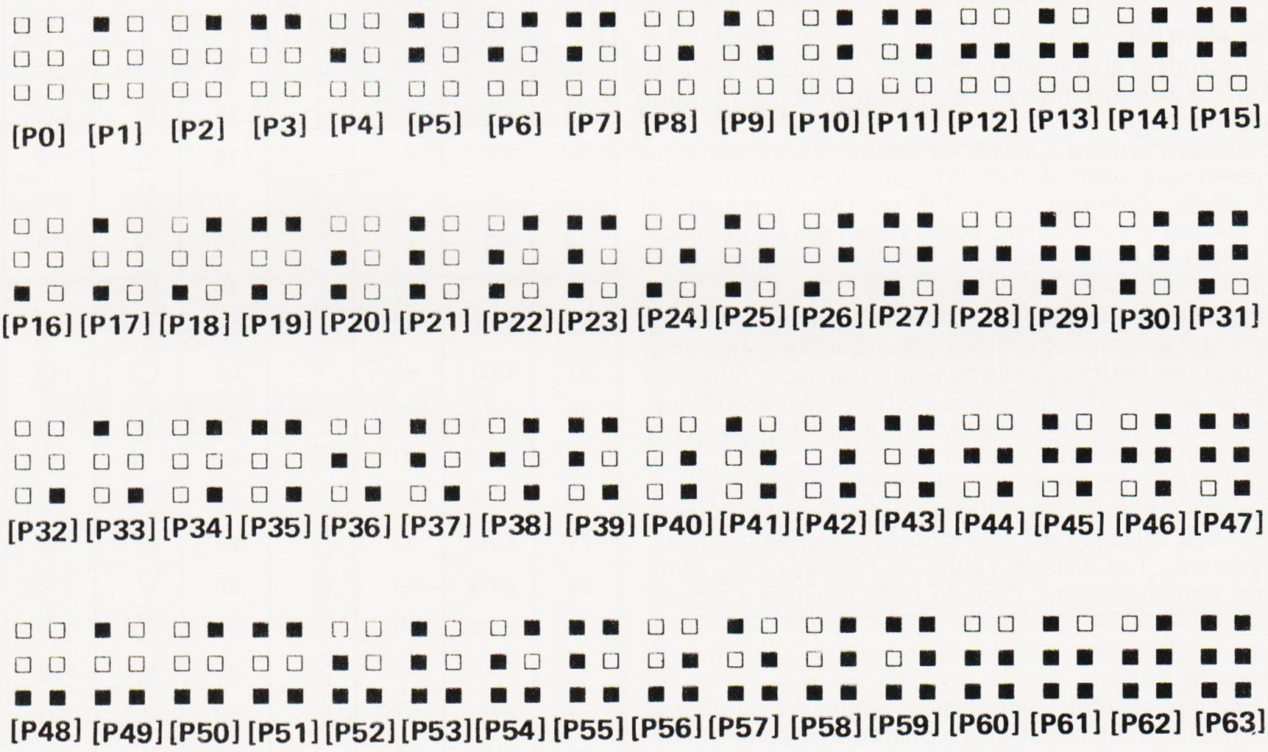
These tables are all compiled with the help of the computer manufacturers' data but some companies seem to be very slow in submitting the information. If you own a machine that has not been featured and you think that it should be then please contact us with the details.

[CD]	Cursor Down
[CU]	Cursor Up
[CL]	Cursor Left
[CR]	Cursor Right
[CLS]	Clear Screen
[HOM]	Home Cursor
[REV]	Reverse Graphics On
[OFF]	Reverse Graphics Off
[SPC]	Space Character

Table 1. The way in which we represent the various cursor controls and screen function commands.

Where's The Rest?

The eagle eyed among you may have noticed that some of the charts that we printed earlier have not been included this time around. Well, we are intending to repeat them in the near future together with some new ones for systems we haven't yet featured. Watch this space!



Pixel Codes

The above codes are generated within each character space as "chunky" graphics. We have given them each a "standard" code for future use.

Not Always!

The exception that always proves the rule, at least as far as pixel codes are concerned, is the Tangerine Micron/Microtan system. This uses a four by two arrangement instead of the Teletext/Viewdata compatible three by two. The logical sequence is identical but extends to a total of 255 possible combinations.

Sharp MZ-80K

Screen Memory:- 53248-54247
D000H-D3E7H
Format:- 25 lines of 40 characters
Notes:- Taking the top left hand corner of the screen as coordinate 0,0 the commands SET and RESET can be used to turn on or off any cell on a 50 by 80 grid thus allowing limited double density plotting. Normal graphic codes are accessed by POKE, CHR$(198) performs a [CLS].

GRAPHIC DETAILS

CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL
0	SP	32	0	64	SP	96	π	128	SP	160		192		224	
1	A	33	1	65	♠	97	!	129	a	161		193	↓	225	
2	B	34	2	66		98	"	130	b	162		194	↑	226	
3	C	35	3	67	■	99	#	131	c	163		195	→	227	
4	D	36	4	68	♦	100	$	132	d	164		196	←	228	
5	E	37	5	69	←	101	%	133	e	165		197	H	229	
6	F	38	6	70	♣	102	&	134	f	166		198	C	230	
7	G	39	7	71	●	103	'	135	g	167		199		231	
8	H	40	8	72	○	104	(	136	h	168		200	H	232	
9	I	41	9	73	?	105	)	137	i	169		201	I	233	K
10	J	42	—	74		106	+	138	j	170	β	202		234	K
11	K	43	=	75		107	*	139	k	171	ü	203		235	
12	L	44	;	76		108		140	l	172	ö	204		236	
13	M	45	/	77		109	×	141	m	173	Ü	205		237	
14	N	46	.	78		110		142	n	174	Ä	206	●	238	
15	O	47	,	79	:	111		143	o	175	Ö	207	☺	239	
16	P	48		80	↑	112		144	p	176		208		240	SP
17	Q	49		81	<	113		145	q	177		209		241	
18	R	50		82	[	114		146	r	178		210		242	
19	S	51		83	♥	115		147	s	179		211		243	
20	T	52		84	]	116		148	t	180		212		244	
21	U	53		85	@	117		149	u	181		213		245	
22	V	54		86		118		150	v	182		214		246	
23	W	55		87	>	119		151	w	183		215		247	
24	X	56		88	↓	120		152	x	184		216		248	
25	Y	57		89	\	121		153	y	185		217		249	
26	Z	58		90	→	122		154	z	186		218		250	
27	£	59		91		123		155	ä	187		219	○	251	
28		60		92		124		156		188	¥	220		252	
29		61		93		125		157		189		221		253	
30		62		94		126		158		190		222		254	
31		63		95		127		159		191		223		255	

The above table for the Sharp has been slightly ammended since our last publications (January '81) to remove some of the confusion over what's black and what's white. All images are printed white on the screen whre you see a black line.

CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL
0	@	32	SP	64		96	SP	128	@	160	SP	192		224	SP
1	A	33	!	65	♠	97		129	A	161	!	193	♠	225	
2	B	34	"	66		98		130	B	162	"	194		226	
3	C	35	#	67		99		131	C	163	#	195		227	
4	D	36	$	68		100		132	D	164	$	196		228	
5	E	37	%	69		101		133	E	165	%	197		229	
6	F	38	&	70		102		134	F	166	&	198		230	
7	G	39	'	71		103		135	G	167	'	199		231	
8	H	40	(	72		104		136	H	168	(	200		232	
9	I	41	)	73		105		137	I	169	)	201		233	
10	J	42	*	74		106		138	J	170	*	202		234	
11	K	43	+	75		107		139	K	171	+	203		235	
12	L	44	,	76		108		140	L	172	,	204		236	
13	M	45	—	77	╲	109		141	M	173	—	205	╲	237	
14	N	46	.	78	╱	110		142	N	174	.	206	╱	238	
15	O	47	/	79		111		143	O	175	/	207		239	
16	P	48	0	80		112		144	P	176	0	208		240	
17	Q	49	1	81	●	113		145	Q	177	1	209	●	241	
18	R	50	2	82		114		146	R	178	2	210		242	
19	S	51	3	83	♥	115		147	S	179	3	211	♥	243	
20	T	52	4	84		116		148	T	180	4	212		244	
21	U	53	5	85		117		149	U	181	5	213		245	
22	V	54	6	86	╳	118		150	V	182	6	214	╳	246	
23	W	55	7	87	○	119		151	W	183	7	215	○	247	
24	X	56	8	88	♣	120		152	X	184	8	216	♣	248	
25	Y	57	9	89		121		153	Y	185	9	217		249	
26	Z	58	:	90	♦	122		154	Z	186	:	218	♦	250	
27	[	59	;	91	┼	123		155	[	187	;	219	┼	251	
28	\	60	<	92		124		156	\	188	<	220		252	
29	]	61	=	93		125		157	]	189	=	221		253	
30	↑	62	>	94	π	126		158	↑	190	>	222	π	254	
31	←	63	?	95		127		159	←	191	?	223		255	

Commodore PET

Screen memory:- 32768-33767
8000H-83E7H
Format:- 25 lines of 40 characters
Notes:- Graphics characters may be converted to lower case alphabetics with POKE 59468,14 and back with POKE 59468,12. CHR$ (147) clears the screen. Note that when outputting screen based information the PET uses an absolute TAB rather than spaces which can disrupt apparently neat formats. For full and well explained details on the PET see the 'PET Revealed' from Computabits, price £10.

GRAPHIC DETAILS

CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL
0		32	SP	64	@	96	NON DISPLAYABLE CHARACTERS	128	PIXEL CHARACTERS	160	PIXEL CHARACTERS	192	CHARACTER COMPRESSION CODES	224	CHARACTER COMPRESSION CODES
1		33	!	65	A	97		129		161		193		225	
2		34	"	66	B	98		130		162		194		226	
3		35	#	67	C	99		131		163		195		227	
4		36	$	68	D	100		132		164		196		228	
5		37	%	69	E	101		133		165		197		229	
6		38	&	70	F	102		134		166		198		230	
7		39	'	71	G	103		135		167		199		231	
8	BS	40	(	72	H	104		136		168		200		232	
9		41	)	73	I	105		137		169		201		233	
10	LF	42	*	74	J	106		138		170		202		234	
11	FF	43	+	75	K	107		139		171		203		235	
12	FF	44	,	76	L	108		140		172		204		236	
13	CR	45	—	77	M	109		141		173		205		237	
14	CURON	46	.	78	N	110		142		174		206		238	
15	CUROF	47	/	79	O	111		143		175		207		239	
16		48	0	80	P	112		144		176		208		240	
17		49	1	81	Q	113		145		177		209		241	
18		50	2	82	R	114		146		178		210		242	
19		51	3	83	S	115		147		179		211		243	
20		52	4	84	T	116		148		180		212		244	
21		53	5	85	U	117		149		181		213		245	
22		54	6	86	V	118		150		182		214		246	
23	32/64	55	7	87	W	119		151		183		215		247	
24	[CL]	56	8	88	X	120		152		184		216		248	
25	[CR]	57	9	89	Y	121		153		185		217		249	
26	[CD]	58	:	90	Z	122		154		186		218		250	
27	[CU]	59	;	91	↑	123		155		187		219		251	
28	[HOM]	60	<	92	↓	124		156		188		220		252	
29		61	=	93	←	125		157		189		221		253	
30	ERL	62	>	94	→	126		158		190		222		254	
31	ERF	63	?	95	—	127		159		191		223		255	

Tandy TRS-80 Model 1

Screen memory:- 15360-16383
3C00H-3FFFH

Format:- 16 lines of 64 characters, selectable to 32 characters.

Notes:- Character codes from 0 to 31 are control codes. Notable ones are; 14-Cursor on, 15-Cursor off, 23-32/64 character select, 29-Reset cursor to start of line, 30-Erase to end of line, 31-Erase to end of frame. Pixel graphics are accessed by codes 129 to 191 inclusive and the remaining 64 are used as TAB generators from 0 spaces to 63 spaces for space commission in programs.

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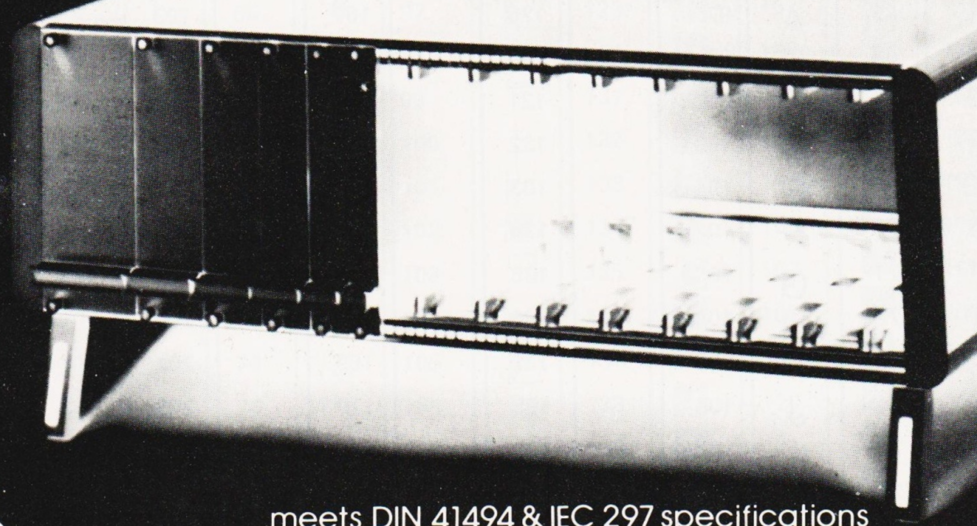

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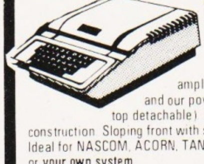

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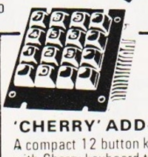

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7420	17p
7421	30p
7422	22p
7423	28p
7425	28p
7426	30p
7427	25p
7428	30p
7430	15p
7432	25p
7433	27p
7437	28p
7438	30p
7440	17p
7441	70p
7442A	50p
7443	112p
7444	112p
7445	60p
7446A	93p
7447A	45p
7448	45p
7450	17p
7451	17p
7453	17p
7454	17p
7460	17p
7470	36p
7472	30p
7473	30p
7474	23p
7475	38p
7476	30p
7480	50p
7481	100p
7482	84p
7483	45p
7484	100p
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	30p
74109	40p
74116	90p
74118	75p
74119	90p
74120	70p
74121	30p
74122	45p
74123	48p
74125	40p
74126	40p
74128	40p
74132	45p
74136	32p
74137	50p
74141	65p
74142	200p
74145	70p
74147	100p
74148	75p
74150	80p
74151A	45p
74153	45p
74154	70p
74155	50p
74156	50p
74157	50p
74159	100p
74160	60p
74161	60p
74162	60p
74163	60p
74164	65p
74165	60p
74166	70p
74167	200p
74170	160p
74172	300p
74173	75p
74174	70p
74175	70p
74176	50p
74177	70p
74178	100p
74180	60p
74181	160p
74182	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
74251	70p
74259	120p
74278	150p
74279	80p
74283	75p
74284	200p
74285	200p
74290	100p
74293	100p
74298	100p
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74LS22	20p
74LS26	20p
74LS27	18p
74LS30	15p
74LS32	16p
74LS33	16p
74LS37	16p
74LS38	16p
74LS40	16p
74LS42	40p
74LS47	40p
74LS51	15p
74LS55	30p
74LS73	25p
74LS74	20p
74LS75	28p
74LS76	20p
74LS83	45p
74LS85	80p
74LS86	24p
74LS90	35p
74LS92	40p
74LS93	35p
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	160p
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	100p
74LS166	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	80p
74LS245	120p
74LS247	70p
74LS251	40p
74LS253	40p
74LS257	45p
74LS258	45p
74LS259	90p
74LS266	25p
74LS273	90p
74LS279	45p
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
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74S30	60p
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74S37	90p
74S64	60p
74S74	90p
74S85	300p
74S86	180p
74S112	300p
74S114	120p
74S124	300p
74S132	160p
74S133	75p
74S138	225p
74S139	225p
74S157	250p
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8205	320p
8212	180p
8216	200p
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(As described in Oct. P.W.)

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16 Way	150
24 Way	280
40 Way	350

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Skt.	350
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14 Way	90
16 Way	120
26 Way	160
34 Way	240
40 Way	280
50 Way	330

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75365	150p
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75491/2	70p
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8T28	140p
8T95	140p
8T97	140p
81LS95	120p
81LS96	140p
81LS97	120p
81LS98	140p
9601	110p
9602	220p

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ZN427E-8	650p

IDC HEADERS

10 Way	220
26 Way	350
34 Way	450

IDC PLUGS

10 Way	150
26 Way	265
34 Way	325

IDC EDGE CONNECTORS

26 Way	390
34 Way	450

IDC DIL HEADERS

14 Way	130
16 Way	150
24 Way	280
40 Way	350

DIL SOCKETS LOW PROFILE

8 pin	9p
14 pin	10p
16 pin	11p
18 pin	16p
20 pin	18p
22 pin	20p
24 pin	20p
28 pin	26p
40 pin	30p

WIRE WRAP SOCKETS

8 pin	30p
14 pin	35p
16 pin	40p
18 pin	50p
20 pin	60p
22 pin	65p
24 pin	70p
40 pin	100p

VOLTAGE REGULATORS

7805	50p
7812	50p
7815	50p
7905	55p
7912	55p
7915	55p
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100KHz	300p
200KHz	370p
1.0MHz	320p
1.008MHz	350p
1.8432MHz	250p
2.00MHz	250p
2.45760M	250p
3.276MHz	250p
3.579MHz	175p
4.00MHz	200p
4.194MHz	250p
4.43MHz	125p
5.0MHz	250p
6.0MHz	250p
6.144MHz	250p
7.0MHz	250p
7.168MHz	250p
8.00MHz	250p
8.867MHz	250p
10.00MHz	250p
10.7MHz	250p
12.0MHz	300p
16.00MHz	300p
18.00MHz	250p
18.432MHz	250p
19.968MHz	390p
626.690MHz	250p
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Some more updates for our guides

Once again we present the latest additions to the ranges of systems and peripherals available on the UK market. As mentioned last month we are only going to print the entire lists every few months now so that there's more room for programs and the like; therefore the information below is grouped into the various categories; Systems, Printers and VDUs.

The information presented in these pages can only be kept up to date if Distributors and Manufacturers keep us informed. If you see information relating to a product which you produce or handle and which you think is incorrect, please drop us a line.

ACORN COMPUTERS

UPDATE

ATOM
Dist:- Acorn Computers
4A Market Hill, Cambridge
0223-312772.

+ 35 dealers.

CPU 6502
RAM 2K/11K
I/O BUS, PARA
CASS CUTS
BASIC 8K
Other FP option
DISC –
m/c YES
£125 kit, £150 built

Extras:- Colour graphics, enhanced BASIC
Applications:- Cased single board with BASIC, can connect to Eurobus
Reviewed:- April '81

Systems 1-5

CPU 6502 or 6809
RAM 1K/32K
I/O PARA BUS
CASS CUTS
BASIC Various
Other Pascal, LISP
DISC 2 x 5¼"
m/c 2K
£65 to £3,000

Extras:- Rack based expansion capability inc Prestel, Cassette, Daisy Wheel, 25 x 80 VDU, PROM programmer, RGB-PAL, ICE, Laboratory and Universal Interface.
Applications:- Single board controller with piggyback Hex + I/O through to word processing, laboratory educational and business use.
Reviewed:- Aug '79

ATARI

UPDATE

ATARI 400
Dist:- Ingersoll Electronics
202 New North Road,
London N1 7BL.
01-226 1200

CPU 6502
RAM 16K
I/O SER
CASS YES
BASIC 8K
Other –
DISC –
m/c shared
£345 inc VAT

Extras:- Printer
Applications:- Programmable games system grown up to home computer.

ATARI 800

CPU 6502
RAM 16K/48K
I/O SER
CASS YES
BASIC 8/16K Microsoft
Other –
DISC –
m/c shared
£645 inc VAT

Extras:- Printer, discs, plug in software, modem
Applications:- Small business & personal use.

EXIDY

UPDATE

SORCERER
Dist:- Liveport Data Products,
The Ivory Works,
St. Ives, Cornwall.
0736-798157.
+ regional dealers.

CPU Z80
RAM 48K
I/O SER/PARA
CASS 2
BASIC Plug In 8K
Other On disc
DISC OPT
m/c 4K
£695

Extras:- Discs, printer, S100 adapter, ROM PACs.
Applications:- Keyboard based system using 'plug-in' software and expanding to discs.

KEMITRON

UPDATE

K3000 SERIES
Manuf:- Kemitron Electronics,
Chester Computing Centre,
21-23 Charles Street,
Chester CH2 3AY.
0244-21817.

CPU Z80A
RAM 4K/256K
I/O SER, PARA
CASS –
BASIC Various
Other Various
DISC 2xDSDD 8"
m/c CP/M, MP/M
£2,300

Extras:- 10Mb hard disc, Cartridge or floppy back-up, more 8" floppies, applications software.
Applications:- Development system, Wordprocessing, business and scientific.

MDS SYSTEM

CPU 8060
RAM 16K/64K
I/O SER, PARA
CASS YES
BASIC YES
Other With optional Z80 processor
DISC 2x8" (with optional Z80)
m/c 2K
£600

Extras:- Peripherals, Discs, Applications software

BASE 2

UPDATE

Z-800
Dist:- Zero One Electronics
Croydon Computer Centre,
29A Brigstock Road,
Thornton Heath, Surrey CR4 7JJ.
01-689 1280

Also Intelligent Artefacts

Face:- Dot
Interface:- RS232/20mA/Centronics/IEEE
Feed:- Tractor/Friction
Head Size:- 5x7
Baud Rates:- 75-9600
Print Speed:- 100cps
Col:- 64/132
Type Sizes:- 2
Graphics Option:- Yes
Price:- £319

Options:- User definable font.
Notes:- Supplier also runs a service and repair centre and supplies ribbons and paper.

ELECTROGRAPHIC

UPDATE

EG1000 FT
Dist:- Electrographic Peripherals,
Printinghouse Lane,
Hayes, Middx UB3 1AP.
01-573 1826

Face:- Dot
Interface:- Centronics
Feed:- Sprocket/Friction
Head Size:- 9x9
Baud Rates:- –
Print Speed:- 80cps
Col:- 136
Type Sizes:- 3
Graphics Option:- Yes
Price:- £575

Options:- RS232/20mA/IEEE/Apple interfaces, Operator selectable character sets.

TRENDCOM

UPDATE

SILENTYPE
Dist:- Microsense
Finway Road, Hemel Hempstead, Herts HP2 7PS
0442-48151

+ regional outlets

Face:- Dot Thermal
Interface:- Apple
Feed:- Friction
Head Size:- 5x7
Baud Rates:- –
Print Speed:- 40cps
Col:- 80
Type Sizes:- –
Graphics Option:- Yes
Price:- £203

Notes:- Custom interfaced TRENDCOM printer for Apple capable of high density graphics.

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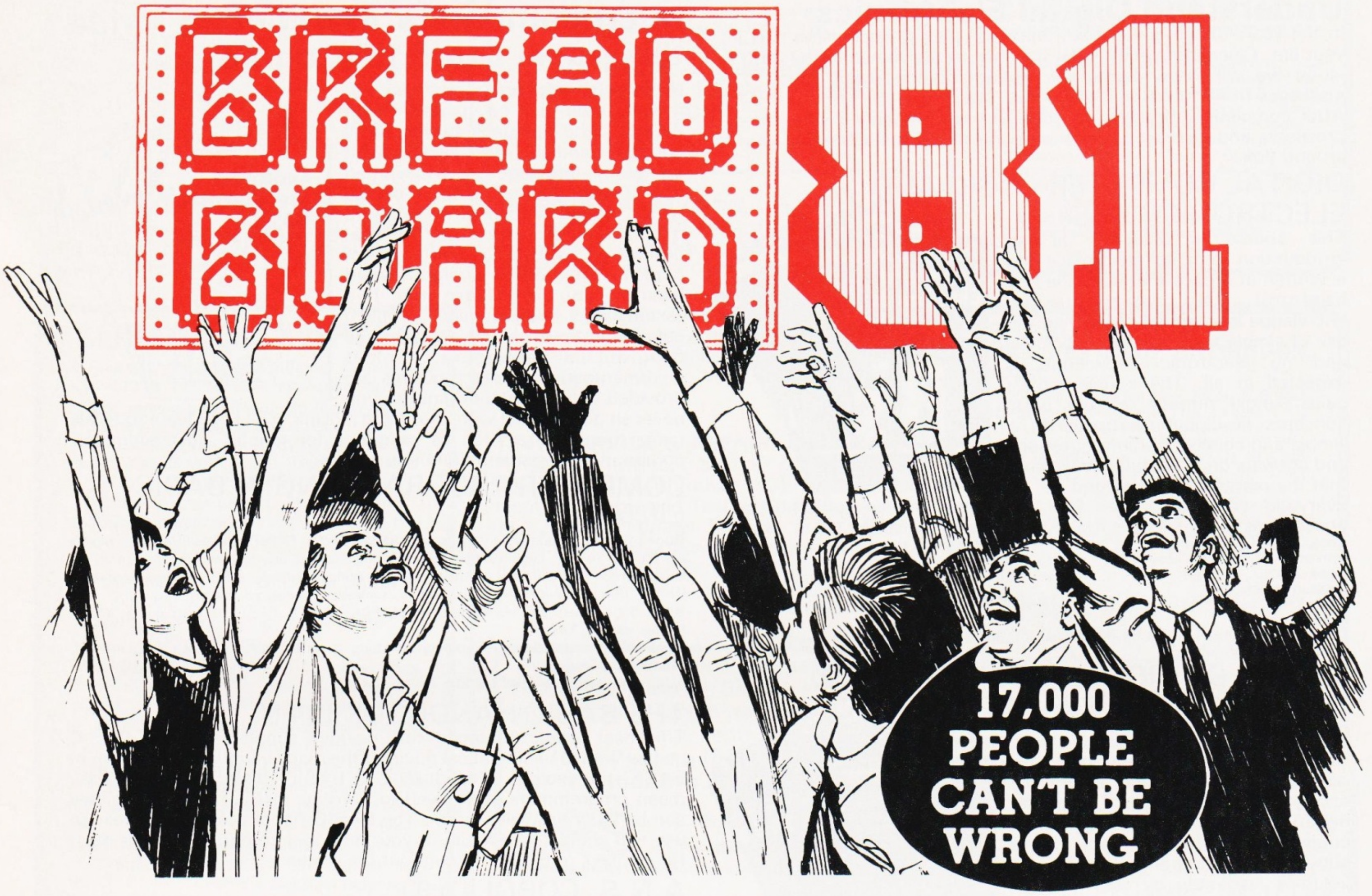
Friday 13th November 10 a.m.-6 p.m. Saturday 14th November 10 a.m.-6 p.m.
Sunday 15th November 10 a.m.-4 p.m.**



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Even those lucky 17,000 would be surprised to hear that this year we've **improved** BREADBOARD still further! More stands, more demonstrations and wider gangways to make it all easier to enjoy!

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Everyone can learn from it - students, engineers, hobbyists, housewives, scientists. Its four A4 volumes consist of:

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Book 3 Positive ECL; De Morgans Laws; designing logic circuits using NOR gates; dual-input gates.
Book 4 Introduction to pulse driven circuits; R-S and J-K flip flops; binary counters; shift registers; half-adders.

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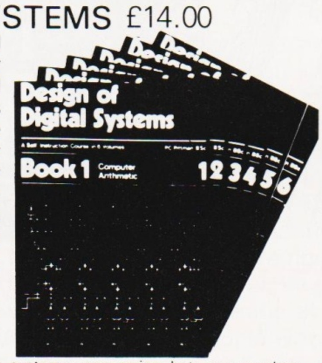

This course takes the reader to real proficiency. Written in a similar question and answer style to Digital Computer Logic and Electronics, this course moves at a much faster pace and goes into the subject in greater depth. Ideally suited for scientists or engineers wanting to know more about digital electronics, its six A4 volumes lead step by step through number systems and Boolean algebra to memories, counters and arithmetic circuits and finally to an understanding of calculator and computer design.

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Book 3 Half adders and full adders; subtractors; serial and parallel adders; processors and arithmetic logic units (ALUs); multiplication and division systems.
Book 4 Flip flops; shift registers; asynchronous and synchronous counters; ring, Johnson and exclusive—OR feedback counters; random access memories (RAMs) and read only memories (ROMs).
Book 5 Structure of calculators; keyboard encoding; decoding display data; register systems; control unit; program ROM; address decoding; instruction sets; instruction decoding; control programme structure.
Book 6 Central processing unit (CPU); memory organization; character representation; program storage; address modes; input/output systems; program interrupts; interrupt priorities; programming; assemblers; computers; executive programs; operating systems and time sharing.

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ZX81 ATOM!

The monthly magazine INTERFACE contains many programs, hints, tips, contact addresses for ZX81, ZX80, Acorn Atom and Proton. Send £1 for a copy of the latest issue, plus details of how to join the National ZX80 and ZX81 Users' Club or the Independent Acorn Atom/Proton Users' Group.

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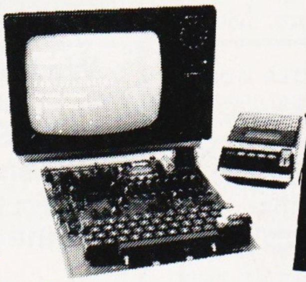

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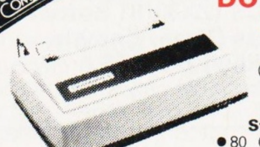

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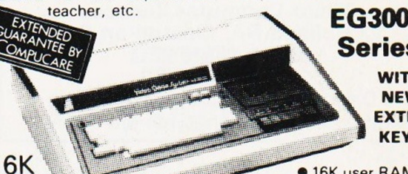

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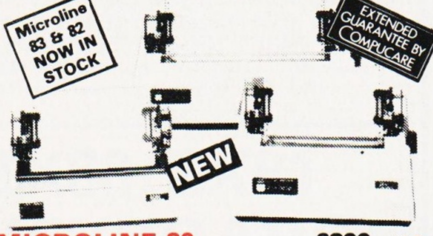

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The Genie has a massive 12k ROM with BASIC interpreter and 16k user memory which is expandable externally up to 48k. There is a full size typewriter style keyboard; power supply, leads and UHF modulator. So it is ready to plug into your TV set or VDU monitor.

Genie also has an integral cassette, and Genie II an extra numeric keyboard. Both are expandable and can take disk drive, printer, colour graphics, and serial port via the expansion box, a most important addition if the system is to adapt to your growing needs.

Perhaps equally important is the huge range of software available. The Genie is fully compatible with the TRS 80 level II software which means that there are literally thousands of ready-made programmes at your disposal.

And finally, even if you have never used a computer before, the easy to follow BASIC manual contains over 100 pages of instructions to take the owner from "plug-in" stage to writing his own programs with which he can command his Genie.

Specification.

CPU Z80
RAM 16k/48k
ROM 12k (10k BASIC, 2k m/c)
I/O Parallel Bus
Full 51 key typewriter style keyboard
107 page BASIC manual
Power supply and leads
UHF Modulator
Fully compatible with all TRS 80 level II software
(1000's of programmes)
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RAM CARD 16k	Printer interface
RAM CARD 32k	Colour graphics
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