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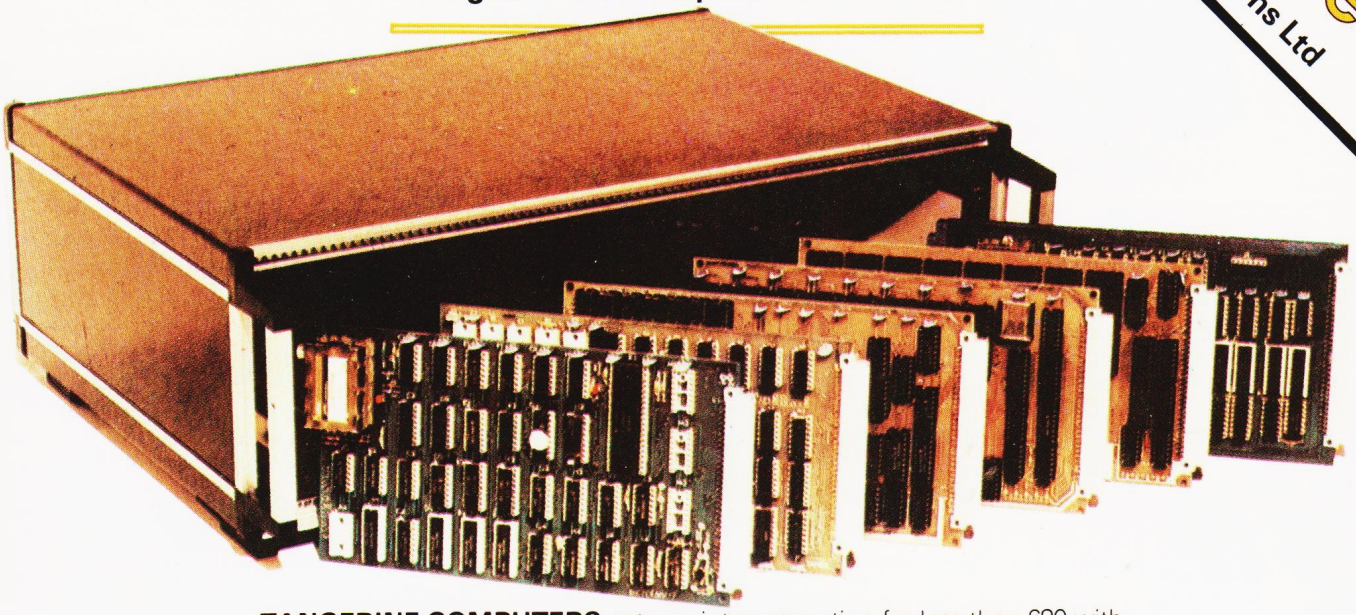

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VOL 3 No 4 JUNE 1981

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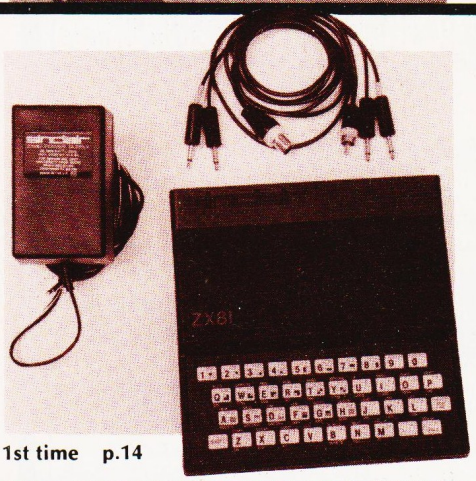

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Computing Today is constantly on the look-out for well written articles and programs. If you think that your efforts meet our standards please feel free to submit your work to us for consideration.

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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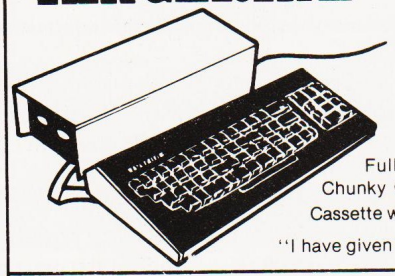

6502 Microprocessor IK Tanbug IK User RAM Full TV Display **£79** (ready-built). 20-way KEYPAD—**£10.**
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Further details of business software available on request

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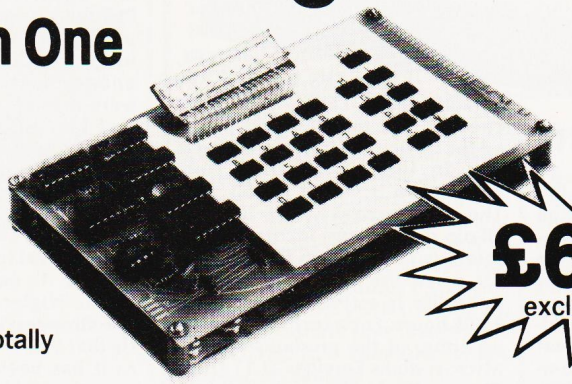

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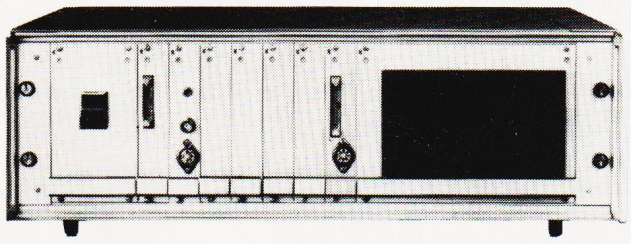

System 3, contains the 6502 CPU, 16K RAM with DOS and BASIC, VDU Interface, Disc controller and 5" drive, Printer Interface, backplane and power supplies. The entire unit costs about £1,000 and can be added to or reformatted as required.

If you need the facilities of the 6809 processor this can be substituted for the 6502 CPU (all other hardware remains unchanged).

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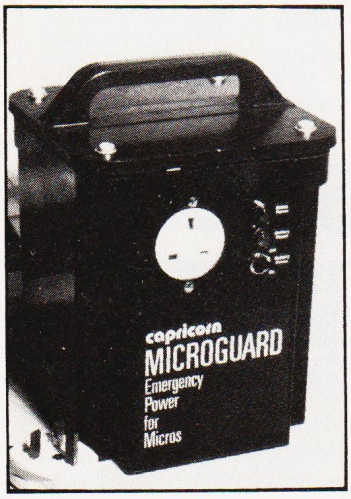
BURN IT IN — BURN IT OUT

Things are really cooking on the EPROM front, if you'll excuse the pun, with a matching programmer/eraser pair from Microsystem Services being the latest additions to the list. The programmer, System 20A, can be used 'stand-alone' or connected to a terminal or a more sophisticated programmer such as the Data I/O System 19. Capable of burning-in 2704, 2708, 2716 and 2732 devices as well as 2564, 2764, 68764 and the Hitachi 48016 EEPROM it even checks to see that you have plugged the device into the correct location in the socket. Data communication is via an RS232 port. The eraser can take up to 10 24- or 28-pin devices and incorporates a safety cut-out to turn the UV tube off when the drawer is opened. Tube life is estimated at around 2,000 hours. For a technical leaflet on either of the products contact Microsystems Services at 11 Duke Street, High Wycombe, Bucks HP13 6EE or give them a ring on 0494-41661.

IN MEMORIAM PART TWO

The second Chris Evans Memorial Lecture is to be held on May 29th at the London Regional Management Centre, 311 Regent Street, London W1R 8AL. The main speaker will be Peter Large, of the Guardian. It is hoped to run a course on the effects of the 'Electronic Revolution' at the same time. While the memorial lecture is free, the course will cost £60 for academics and £80 for others. Applications for tickets for either event should be sent to the LRMC at the above address.



PORTABLE BACK-UP

If you feel that your computer should be 'power-cut-proof' then a new product from Capricorn Computer Systems might be worth a look. Called Microguard, it is a standby power source capable of keeping your micro up-and-running, together with its printer, for two to three hours after the mains fails. Completely automatic in operation, it is based on a 12 V car battery with an invertor circuit capable of supplying 100 W for a minimum of two hours from a charged 40 A/hr battery. The device costs £275 plus the inevitable VAT and will be available ex-stock from mid-April, For further information contact Capricorn at 24 Foregate Street, Worcester.

COMMODORE MEETS ITS WATERLOO

On Friday, April 3rd, a select party of computer journalists met, bleary-eyed, at Heathrow Airport. Their destination, in the comfort and exclusivity of Commodore's PET Jet, was the Hanover Fair. The plan of action for the day was to listen to the new product announcements that Commodore were making at the fair, products that may well soon emerge onto the UK market. Star of the day's proceedings, at least as far as the German public was concerned, was the VIC 20. Now fitted with PAL colour it is going to be a serious rival to the ATOM, but only when it's equipped with the optional High-res graphics board. The strongest advantage in the battle that VIC — the Volkscomputer, as it has been christened in Germany — will have to fight is that it can run all the existing software for the PET. As far as the upmarket customers are concerned Commodore have some very interesting products on-line. The recently reviewed SuperPET has been selling well but has not conquered the small business market in as dramatic a way as was hoped. Their solution is the Waterloo machine, the MicroMainframe in Commodore's parlance. This is a dual CPU (6502 and 6809) system with 96K of RAM as standard. All the languages are 'soft', they are downloaded from disc and the range includes FORTRAN, APL, Business BASIC, Pascal and an Assembler. The unit is equipped with a full RS232 communications interface and software can be provided to connect it to mainframes like IBMs and DEC PDP 11s. The user always has 32K of program space although there is no reason why this could not be expanded. Other equipment on show was a 96K version of the SuperPET, a 32K colour version of the 3000 series, a couple of dual 8" floppy drives and a 6Mb hard disc with an 8" floppy as back-up. Most of these products will undoubtedly appear in the UK at the time of the PET Show, 18th-20th June at the West Centre Hotel in London.

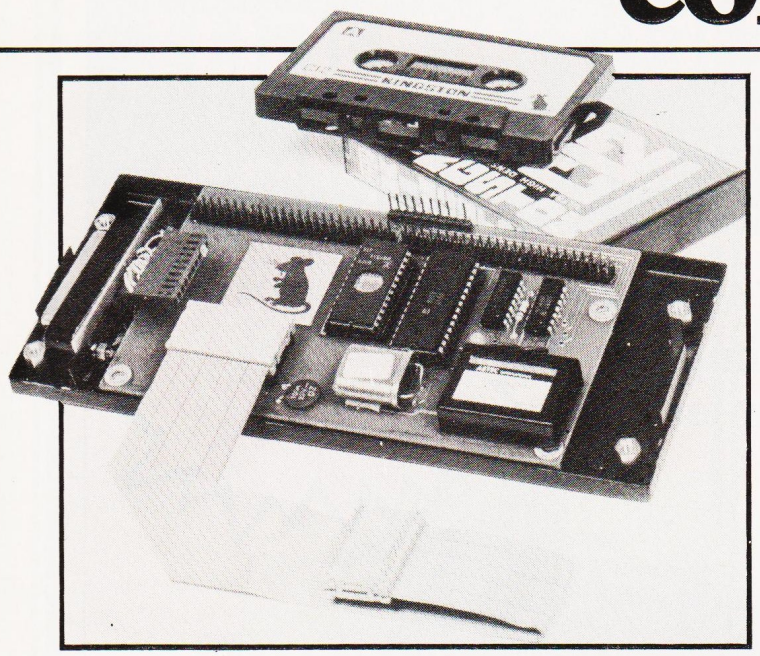
ON COURSE

The Sira Institute are holding a number of courses over the next few months. Three are being staged at the Cudham Hall, Cudham, Sevenoaks and are residential. The titles are 'Microprocessor Familiarisation' on 15th/16th June, 7th/8th September and 16th/17th November; 'Using Micro Based Equipment' on 17th/19th June and 18th/20th November; and 'Micro Based Equipment Design' on 8th/12th June and 9th/13th November. A further one-day course is planned on 'Using Personal Computers in Industry' and is scheduled for 21st October at the Royal Overseas League in London. For further details contact the Conference and Courses Unit, Sira Institute, South Hill, Chislehurst, Kent BR7 5EH or ring on 01-486 7941. Agar Computer Services are offering two-day courses in BASIC programming, once again. Dates for June are 1st/2nd, 6th/7th, 9th/10th, 11th/12th, 16th/17th, 20th/21st, 23rd/24th and 29th/30th. The fee for each session is £57.50, inclusive of VAT. For further information contact Mr Agar-Hutton at 194 Kilburn High Road, London NW6 or ring on 01-328 9232. The Worcester College of Higher Education are running their sixth annual summer school between 31st July and 7th August. This year's topic, 'Using Microprocessors', covers both hardware and software with RML 380Z and Commodore PETs available for hands-on use. Applications should be sent to the Director of Summer School, Worcester College of Higher Education, Henwick Grove, Worcester WR2 6AJ and should arrive before June 22nd. Residential costs are £41, excluding lunches, and the tuition fee is £120. School and college applications may be eligible for a 60% subsidy, reducing this to £48.

GRAND MET BRANCH OUT

High-Tech, part of the Grand Metropolitan group, have been expanding their range of S100 compatible products and among their latest releases is an intelligent Viewdata terminal. Based on the North Star Horizon, if offers an in-house capacity of up to 340 frames per disc with a full editing keyboard and a colour display. An autodial modem is also available for connection to the Prestel system. The complete package costs £2,605. The unit is also available as a straight editing terminal at £895. At board level, High-Tech have introduced an S100 talking card based on the National Semiconductor Digitalker. As previously reported in our News pages the device uses 128K of ROM to store a vocabulary of 144 words spoken in English and compressed electronically. The speech quality is much more natural than the synthesised variety. Potential use for a device such as this, quite apart from the personal computer market, is with the telecommunications industry's new generation of electronic exchanges and the board is currently being evaluated by British Telecom. Access to the stored words is by a simple look-up table that addresses the corresponding location in ROM. The card will cost £185 and further details on both the card and the Viewdata terminal can be obtained from High-Tech at 54 High Road, Swathling, Southampton, Hants SO2 2JF or by ringing Tim Roberts on 0703-581555.

CONSUMER NEWS



KIT OUT A PET

Kingston Computers seem more than happy with the success of their NETKIT in the industrial marketplace judging by the recent press release listing companies currently using them. The interface connects to a new ROM PET through one of the spare ROM sockets and provides a full RS232 serial port and duplicates the PET's internal memory expansion port. The device allows PET to act as a dumb terminal or, by using the increased BASIC command set, as an intelligent terminal. Programs can be loaded into PET from other terminals or computers. This facility enables users like Anderson Strathclyde to load programs for NC machines into the PET for analysis and modification, a job previously done by hand. For a detailed booklet on the NETKIT contact Kingston Computers at Electricity Buildings, Filey, North Yorks YO14 9PJ.

LUXOR RE-LAUNCH

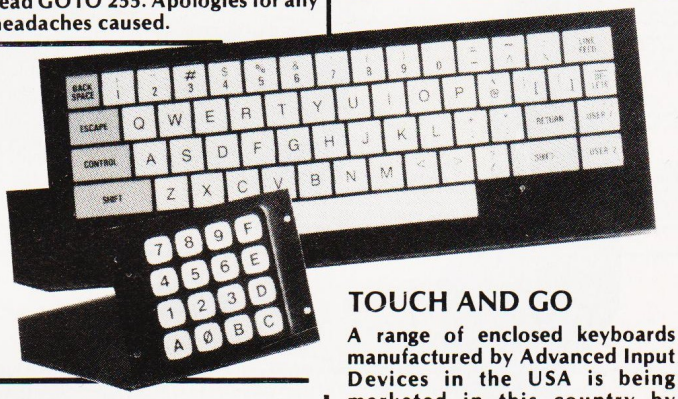
The ABC-80 computer from Luxor is being given a new injection of life in the UK. Over the last two years the machine has sold in excess of 15,000 in Scandinavia — mainly into the industrial and scientific markets. Offering a 16K BASIC and 16K of user RAM (expandable to 32K) it includes a VDU and cassette-based storage although up to 2Mb of floppy disc can be fitted. CPU is a Z80A and among other attractive features the system is Viewdata compatible. A wide variety of interfaces are available, including links to mainframes such as IBM 3780s. For full product details contact Datormark Ltd, Fox Oak, Seven Hills Road, Walton-on-Thames, Surrey KT12 4DG.

BUG BYTES

A couple of typographic errors slipped into the listings of Snakes in our Softspot Special published in April. The DIM P(100) statement should be put at the beginning of the program and not at line 135; there is an 'open quotes' (") missing after the second PRINT in line 24; and, worst of all, line 1620 should read GOTO 255. Apologies for any headaches caused.

EVEREST UNTITLED

The author of last month's featured program, Everest, was Simon Bunce. Our apologies for omitting the name from the heading of the title. Those responsible are now wearing the traditional sackcloth and ashes!



TOUCH AND GO

A range of enclosed keyboards manufactured by Advanced Input Devices in the USA is being marketed in this country by Quiller Components. Based on the 'collapsing dome' technique they are available in a wide variety of types including custom-designed variants. All are totally sealed against dust and spillage with a heavy duty option for harsh environments. The key legends can be embossed for greater definition or supplied as a flat panel, and the keys themselves can be set singly in bezels or on a sheet. For prices and details contact Quiller at St Leonards Road, Bournemouth, Dorset BH8 8PA or ring on 0202-291015.

THE CORE OF CAI

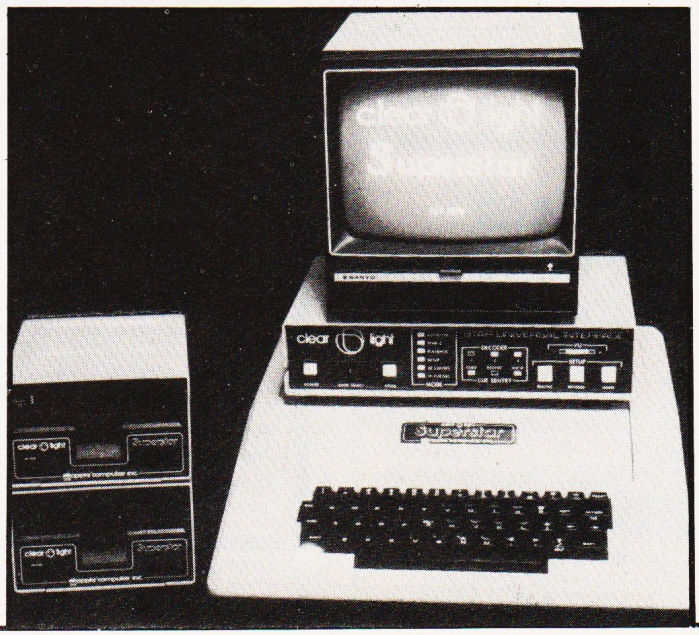
Apples can now be fitted with PILOT, the language for Computer-Aided Instruction. Based on the standard defined by Western Washington University, it incorporates all the commands of common PILOT plus all the facilities added such as graphics and sound. The hardware required is a 48K Apple with DOS 3.3 and two drives if the system is to be used for the creation of lessons and tutorials. The price is £76 including the necessary documentation. A data sheet is available from Microsense Computers at Finway Road, Hemel Hempstead, Herts HP2 7PS. Microsense are also offering 20% off Apple products for educational establishments during April and May.

RAMS POWER DOWN

Hitachi have introduced a low-power, high-speed static RAM device designated HM6116. Organised as 2K by 8 it features an access time of 120 nS and only uses 20 uW on standby. Based on a mix of NMOS and CMOS it joins a growing family of devices with low power consumption suitable for use in battery-powered equipment. Power is taken from a single 5 V rail with an operating requirement of 160 mW. Packaged in a 24-pin DIL, the devices are pin compatible with industry standard 16K EPROMS. A data sheet on the product is available from Hitachi at PIE Building, 2 Rubastic Road Southall, Middx UB2 5LL.

LET THERE BE LIGHT

Did you go to the British Genius Exhibition in Battersea Park a couple of years ago? If you did then one of the more stunning exhibits you will have seen must have been the audio-visual display using a multi-screen, multi-projector set-up all controlled by a vast bank of computerised thingumabobs. Impressive it certainly was but the technology used has moved on a step or two since. A new AV controller based around the Apple is now being imported into the UK by Myriad Audio Visual Sales and is equipped with its own special control language called AMPL/1. Developed by Clear Light of Fort Lauderdale, Florida, the system couples the Apple to a special controller to drive the projectors etc and also allows you to use the Apple's graphics facility to produce slides. The Apple is supplied with dual discs, a 9" VDU and the Universal Interface. If you are into creative AV or are just fed up with getting your slides in a muddle, you can contact Myriad at 10/11 Great Newport Street, London WC2 or ring them on 01-240 1941.



BUS ROUTE '80

One of the major nuisances of the ZX 80, and probably the '81, is that hardware expansion is currently limited to that supplied by Science of Cambridge. JMJ Interfaces are seeking to change that with their plug-in port interface, recently announced as retailing at £29. Configured on a standard Z80 PIO it gives access to 16 I/O lines and their associated controls via a 24-pin DIL socket. Software for driving the port is supplied on a C12 cassette along with a manual giving details of experiments that can be carried out. JMJ are also in the process of producing a backplane for the ZX 80, which will be fully compatible with the 16K RAM pack and will release a further 8K of memory space for future use. Contact JMJ Interfaces at Old School House, Rettendon Turnpike, Battlesbridge, Wickford, Essex.

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- ★ CHARACTER CODE - ASCII
- ★ PRINT SPEED - 30 characters/second
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- ★ LINES/INCH - 6 (9 for graphics)
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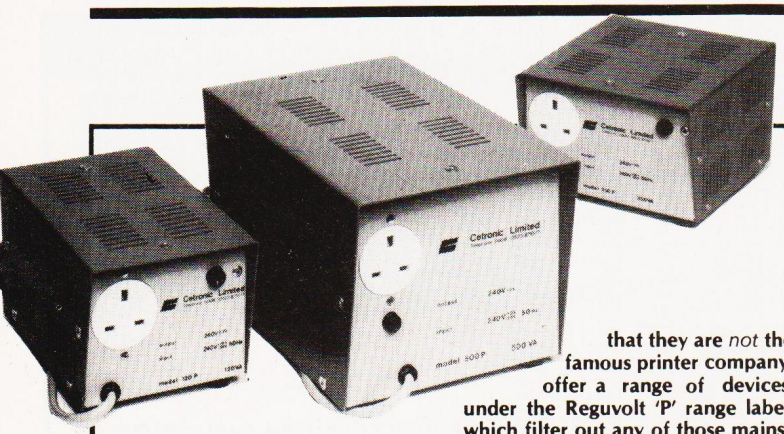
.....CT4



CLEAN IT UP

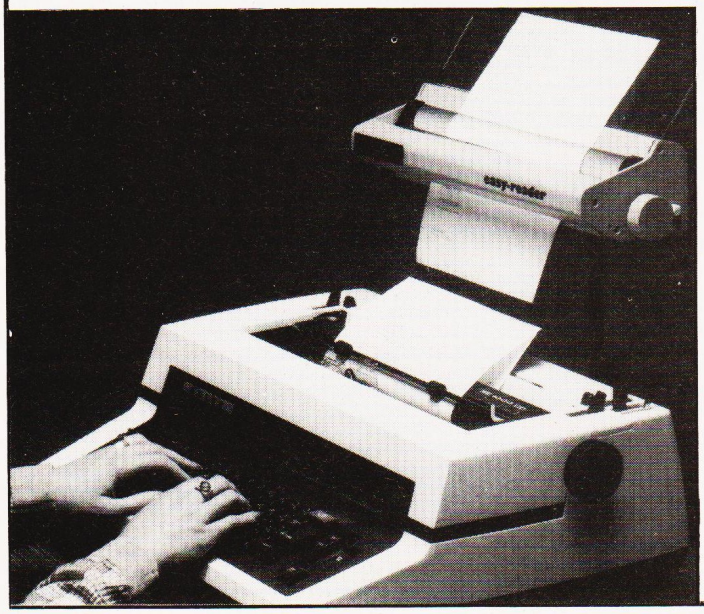
If you are troubled by a 'spiky' mains supply, whether caused by domestic appliances or industrial machines, which threatens your micro's efficiency, then it's time to clean it up. Cetronic (who wish to make it clear that they are *not* the famous printer company) offer a range of devices under the Reguvolt 'P' range label which filter out any of those mains-borne nasties which can cause disaster. Available in 120, 250 and 500 VA ratings, they are suited for personal and small business installations. For further information contact Cetronic at Hoddesdon Road, Stanstead Abbots, Ware, Herts SG12 8EJ or ring them on 0920-871077.

COMPILE IT!

If you are selling or developing commerical software for the Commodore PET and are worried either by the lack of memory space or the possibility of having your software 'borrowed', then Drive Technology may have the answer to your problem with their new Compiled BASIC. Fully compatible with the Interpreter supplied on the PET, it comes in two forms. The standard package, DTL-BASIC, is simply a compiler: it reduces the BASIC to 6502 machine code which is obviously faster to run and takes less memory space. The second product is an enhanced version of the first which gives you software security. You can write progams under the Interpreter for ease of development before compiling. The protected version will only operate on specially formatted discs which are claimed to be totally copy-proof, unless of course you have the master. Prices for the 3000 series machines are £300 for the standard package and £900 for the protected version. Manuals are available separately at £15 each and Drive Technology also offer a maintenance service. The specially formatted discs cost £180 per box of 10 although quantity discounts are available. For further information contact Drive Technology at 318 Ringwood Road, Ferndown, Dorset BH22 9AT.

EASY READING

If your company typist does a lot of copy work then you might like to improve her lot a little with a new device called Easy Reader. Produced by the Power Equipment Company, it is an illuminated, magnifying, electrically operated copy stand. Put in simpler terms, it passes the original document under a magnifying strip which is illuminated to highlight the line you are currently copying. Feeding of the document is controlled by a footswitch. It can be used with any keyboard device from a VDU down to a humble typewriter. Also on offer from the company this month is a silencer cabinet for Diablo 1600 Series KSR printers. Swallowing up to 80% of the noise produced by the printer, it will make life in the office that bit quieter. Technical details on both the products can be obtained from the company at Kingsbury Works, Kingsbury Road, London NW9 8UU.

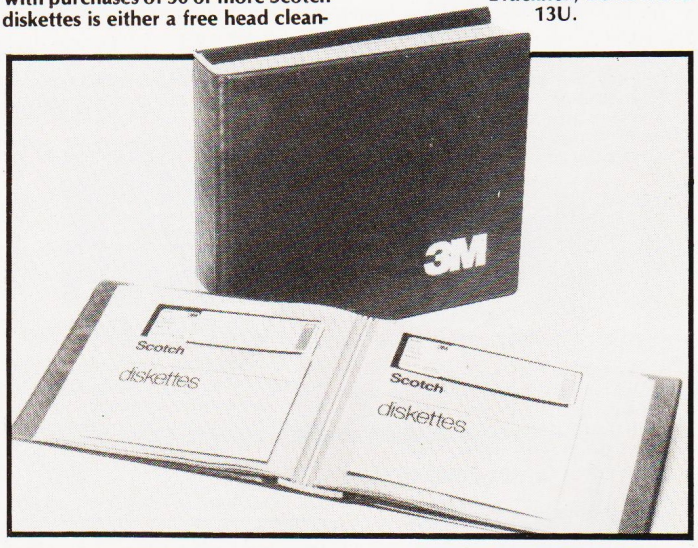


TEXAS GOES VISUAL

Texas Instruments have announced a new venture in the terminal market — their first stand-alone VDU, called the Opti 940. It is the first in a new range and costs £1,180. The experience they gained with their 911 VDU, only available as part of a complete system, has gone into the design of the new product. Featuring a detached keyboard divided into functional groups, a tiltable display in either standard, amber or green, and all the other features one normally expects from an editing terminal, it will go into volume production in June. Texas are also producing a new variant of their successful Omni 800 data terminals. The new Model 840 is a 75cps device and will be available in KSR and RO versions, priced at £820 and £730 respectively. Standard features include bi-directional printing with a 9 by 7 matrix head and a 132 column carriage. For more information on either product contact Texas Instruments at Manton Lane, Bedford MK41 7PA.

GIVING IT AWAY

If you buy floppy discs in bulk then 3M's offer might sway your mind this month. Available to the end of May with purchases of 50 or more Scotch diskettes is either a free head cleaning kit or a 20-disc binder. The freebie can be obtained from any authorised distributor or direct from 3M at 3M House, PO Box 1, Bracknell, Berks RG12 13U.



STAR RISING

Following the success of the Microstar in the UK, Data Efficiency are launching its twin brother, the Microstar II. Configured around a 16 bit CPU, 128K of RAM and 20Mb of mass storage, it can handle up to five users and one background job, and a printer can replace one of the stations. Users can swop from multi-user WP to DP; all the packages are written in Business BASIC. Typical offerings for the business user include Sales, Purchase and General ledgers, Stock Control, Payroll and Personnel information, and packages written for the earlier version are compatible. Typical hardware costs are around £7,200. Further information is available from Data Efficiency at Maxted Road, Maylands Avenue, Hemel Hempstead, Herts HP2 7LE or ring on 0442-63561.

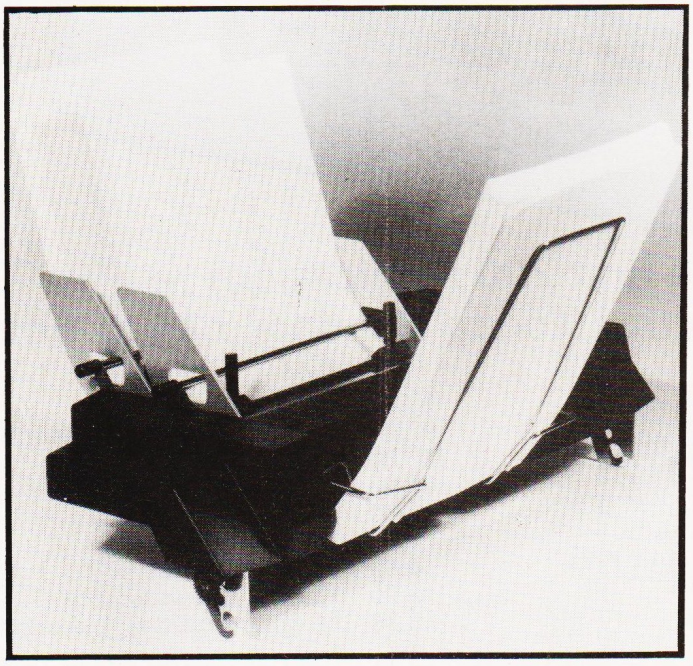
BUSINESS NEWS

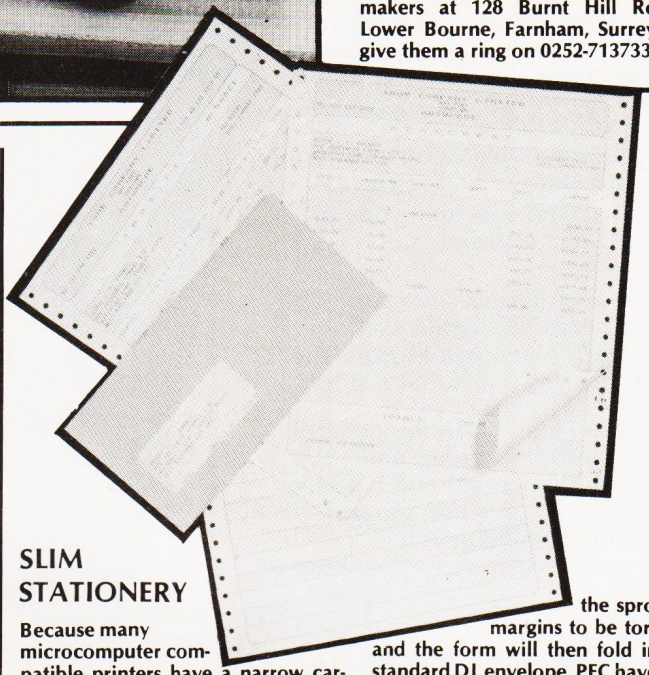
WORDSTAR SHINES ON

The CP/M-based Wordstar word-processing package has acquired an extremely useful hardware addition — the Kaythorn 80. Although Wordstar has a menu available on-screen it only displays a small selection of the available functions. What Kaythorn have done is to provide a special keyboard with a key for each function, 80 in all, which can considerably speed the operator's job. All the function keys are labelled as to their actual function rather than the normal CONTROL sequence which would have to be typed on the VDU keyboard. Although these are only available for Wordstar at the moment, Kaythorn hope to launch more versions for other text processing packages. You can contact the makers at 128 Burnt Hill Road, Lower Bourne, Farnham, Surrey or give them a ring on 0252-713733.

DOUBLE PRINTING

Sheet-fed printers suffer from one drawback: you continually need to change the sheets, headed paper, continuation sheets, etc. Zygal Dynamics are now offering a twin-feed hopper unit for printers like the Diablo and Qume which should cut this problem literally in half. Each of the hoppers can hold up to 200 sheets, which are fed through the printer in the correct order by the printer and then stacked in the correct order. For details on this or any of the other paper-handling devices that Zygal market, contact them at Zygal House, Telford Road, Bicester, Oxon OX6 OXB, or ring on Bicester 3361.





SLIM STATIONERY

Because many microcomputer compatible printers have a narrow carriage, typically 9½", PFC (Continuous Forms) of Cradley Heath have introduced a special set of narrow two-part stationery. Designed to provide a universal format for invoices or statements, the top sheet is printed in green and the lower in brown. Vertical perforation allows the sprocket margins to be torn off and the form will then fold into a standard DL envelope. PFC have also introduced narrow width listing paper in blue, brown and green. The paper is shrinkwrapped in packs of 500 sheets. Further information and samples are available from PFC at Waterfall Lane Trading Estate, Cradley Heath, West Midlands B64 6PZ.

CANON EXPANDS ITS BUSINESS

Two small business computers and a pair of matching printers have been announced by Canon, the camera people. The BX-3 System is a desk-top machine with a built-in 80 column printer, 28 character display panel, twin discs and a full keyboard. The CX-1 is basically the same except that the display and printer are replaced by a 12" green VDU. The operating system includes database management facilities and word-processing software is available. The two printers are the PT-80 which is an 80 column thermal device, and the PW-80 which is an 80 column matrix type. The products are to be shown at the Hanover Fair and will become available in the UK during the summer. For technical details contact Canon Business Machines at Waddon House, Stafford Road, West Croydon, Surrey CR9 4DD, telephone 01-680 7700.

HP GO SOFT

Hewlett Packard have announced some more software for their Series 80 personal computers. Among the offerings is a database management system which can maintain and analyse a database, mailing list, customer records and so on. The second piece of software is a Graphics Presentation Pac which lets the user create diagrams for inclusion in reports or for overhead projection. Among its varied features are three different character sets and six different styles of lines and hatching. They both join the previously announced VisiCalc Plus, and doubtless more will follow. All are priced at £108 excluding VAT. Further information is obtainable either through your local HP dealer or from the Personal Computation Products Division at 308-314 Kings Road, Reading, Berks RG1 4ES.

ACT OPEN FOR BUSINESS

A computer-shop with a difference has been opened in Halesowen. Owned by ACT, the bureau and micro company which also produces software under the ACT Microsoft label, it is intended to operate rather like a supermarket for local businessmen. Stocking most of the requisites that a commercial micro user might need, for example listing paper, discs, software and computers like ACT's own 800 series, it also offers technical support. If you're in the area, why not drop in? It's at Shenstone House, Dudley Road, Halesowen, West Midlands B63 3NT. Opening hours are Monday to Friday, 9.15 to 5.15.

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Programme

9.30	Seminar Registration
10.00 - 11.00	Lecture I*
11.00 - 11.30	Break for Coffee
11.30 - 12.30	Lecture II*
12.30 - 14.00	Lunch
14.00 - 15.00	Lecture III*
15.00 - 15.30	Break for Tea
15.30 - 16.30	Question and answer forum
17.00	Seminar closes

* The order of lectures will be confirmed later.

TTLs by TEXAS

7400	11p
74S00	60p
7401	12p
7402	12p
7403	14p
7404	14p
7405	18p
7406	30p
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7408	17p
7409	19p
7410	15p
7411	24p
7412	20p
7413	30p
7414	40p
74C14	90p
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74365	60p
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74LS393	90p
74LS399	120p
74LS445	140p
74LS640	450p
74LS641	450p
74LS642	450p
74LS643	450p
74LS644	450p
74LS668	100p
74LS670	250p

74S SERIES

74S00	60p
74S04	60p
74S05	75p
74S08	75p
74S10	60p
74S20	60p
74S30	60p
74S32	90p
74S37	90p
74S64	60p
74S74	90p
74S85	300p
74S86	180p
74S112	120p
74S114	120p
74S124	300p
74S132	160p
74S133	75p
74S138	225p
74S139	225p
74S157	250p
745163	300p
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6850	200p
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8155	950p
8205	320p
8212	200p
8216	225p
8224	275p
8226	250p
8228	250p
8251	450p
8253	800p
8255	450p
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MC3487	300p
MM58174	£12
75107	160p
75110	200p
75112	150p
75114	150p
75115	150p
75154	175p
75182	230p
75324	375p
75361	200p
75365	150p
75451/2	72p
75491/2	70p
8T26	160p
8T28	160p
8T95	160p
8T97	160p
81LS95	120p
81LS96	140p
81LS97	120p
81LS98	140p
9601	110p
9602	220p

FERRANTI

ZN425E-8	400p
ZN427E-8	750p

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

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8 pin	30p
14 pin	35p
16 pin	40p
18 pin	50p
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1A +5V	60p
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Large range available	

CRYSTALS

32.768KHz	250p
100KHz	300p
200KHz	370p
1.0MHz	320p
1.008MHz	350p
1.8432MHz	325p
2.00MHz	325p
2.45760MHz	325p
3.276MHz	300p
3.579MHz	175p
4.00MHz	290p
4.194MHz	POA
4.43MHz	125p
5.0MHz	325p
6.0MHz	300p
6.144MHz	300p
7.0MHz	300p
7.168MHz	300p
8.00MHz	300p
8.867MHz	300p
10.00MHz	310p
10.7MHz	300p
12.0MHz	350p
16.00MHz	350p
18.00MHz	300p
18.432MHz	350p
19.968MHz	390p
26.690MHz	350p
27.145MHz	325p
38.6667MHz	350p
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Peter Freebrey

We take the lid off Clive Sinclair's latest offering. Can it really do all that it promises with only four ICs? For the answer to this and other vital questions read on.

Just how many times can we say "have Sinclair done it again"? This latest offering will surely be difficult to beat and, at just less than £50 as a kit (£70: ready-built), has got to be a difficult system to criticise! It works well and, within the limitation of the on-board 1K of RAM, the review model has already given me many hours of pleasure. Of course there are some features (not many!) on other micros that the ZX81 either has not got or are slightly inferior or inconvenient in operation. . . . but look at the difference in price. What the ZX80 did for thousands I'm sure the ZX81 will do for many more. The ZX80 seems to have a strong appeal to both those who are involved with computers in their occupation and also those who are completely new to this field. The ZX81 has much more to offer for less money, and unless another micro with similar specifications comes on the market at around about the same price, I can hardly see how the ZX81 can fail.

The Case In Point

The ZX81 gives the impression of being more robust than the ZX80, and although the keyboard is still the now familiar 'touch type' as on the ZX80, I find the slightly textured matt finish gives me a greater feeling of control than its glossy forerunner. The ZX81 comes complete with separate mains power supply and leads to connect it to your TV set and tape recorder. The 212-page instruction manual is comprehensive and is Sinclair's best yet. The ZX81 uses the new 8K ROM which was announced last year and which, until now, has been so elusive. There are some 20 commands and/or statements that were not available to the ZX80. From the list of these in Table 1 you can see that they include the option of a FAST or SLOW mode — this is certainly a useful improvement. When running in the FAST mode the ZX81 operates in a similar manner to the ZX80 — fast operation, with a very noticeable flicker on the display whenever a key is operated or command actioned together with a blank grey screen while computations are taking place. In SLOW mode operation you get a flicker-free picture. Although the ZX81 does not have a memory mapped display, it refreshes and updates the screen information while still proceeding with the program it is running. This mode is much slower in operation: a FOR . . . NEXT loop of 10000 takes 176 S in SLOW and 44 S in FAST mode. Even though SLOW really does mean slower operation it gives the user the option of using moving graphics apart from making the display less of a strain to the eyes!

Whereas the ZX80 was limited to integer calculations the ZX81 has a full floating point notation and this has meant the addition to its repertoire of such functions as logs and trig. These, together with its ability to PLOT pixels (quarter square graphics) means you can draw, among other things, sinewaves across your TV screen to your heart's content!

Another advantage of the new 8K ROM is the option of adding a printer to your system. The ZX printer (available in June) offers full alphanumerics across 32 columns and the ZX81 has the commands necessary to LPRINT and LLIST to the printer. It also has the facility to COPY, which will print out exactly what is displayed on the TV screen without further commands.

Programming Techniques

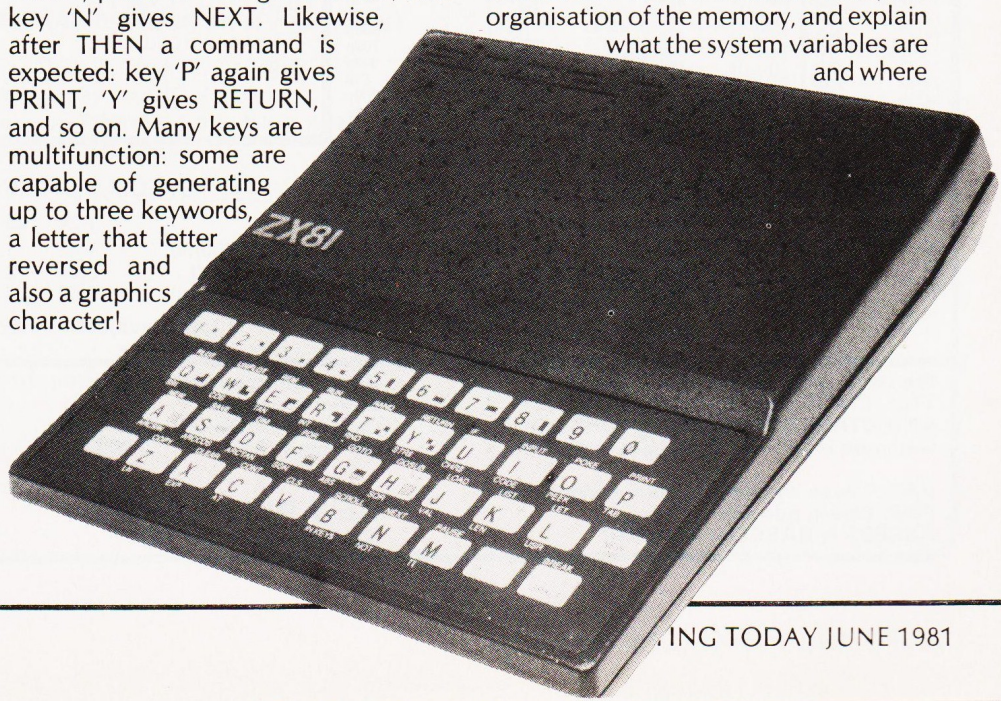
For those not familiar with the ZX80, the ZX81 uses a 'one touch' keyword entry technique — when you have entered a program line number the next requirement *must* be a command of some description. The ZX81 recognises this necessity and the next single key pressed will result in the related command being entered and appearing on the screen in front of you. If you have entered a line number and then press key 'P' you will actually enter PRINT, press 'H' and get GOSUB, and key 'N' gives NEXT. Likewise, after THEN a command is expected: key 'P' again gives PRINT, 'Y' gives RETURN, and so on. Many keys are multifunction: some are capable of generating up to three keywords, a letter, that letter reversed and also a graphics character!

Initially this can be a little daunting, not to say confusing, but you will soon get used to the operation of the keyboard. It has a fairly logical sequence and like any new keyboard can pose an unfamiliar operator with a few initial problems.

The cursor takes the form of a reversed character: if 'K' is displayed this indicates that a keyword will be generated, should the next key pressed have such a function. If the cursor displays a 'G' then either a graphics symbol or a reversed character will appear. A reversed 'F' indicates that a further set of keywords such a SIN, COS, RND will be called. Should a reversed 'S' be displayed then you have a syntax error and the ZX81 will not allow the entry of that line to the program until you have made the necessary correction.

Reading Matters

The manual has 28 chapters and three appendices. Chapter 1 gives instructions on how to connect and set up the ZX81 for operation initially. It also recommends that those already knowing BASIC should read Appendix C to familiarise themselves with ZX81 BASIC and use the remainder of the instruction manual as reference as and when needed. The main bulk of the book is for the novice, explaining clearly and concisely all the statements and commands. Most of the chapters are essentially a 'hands-on' teaching programme in ZX81 BASIC, with a number of useful exercises to extend the knowledge gained in the preceding text. Chapters 26,27 and 28 introduce the idea of machine code, the organisation of the memory, and explain what the system variables are and where



they are stored.

Appendix A lists the character set, Appendix B gives the Report (Error) codes and Appendix C give a short résumé of the ZX81 and its individual characteristics under the heading: "The ZX81 for those that understand BASIC." The Index is useful and comprehensive, giving not only page references but also the key sequences required for all keywords and shifted characters.

Those who already have some knowledge of BASIC will note from the command/statement list that there are a few common BASIC commands that are noticeable by their absence, principally DATA, READ, RESTORE, ON-GOTO, LEFT$, MID$, RIGHT$ and TL$. These are listed in the index but not in the bold type, indicating that they are ZX81 keywords. Although the ZX81 does not have these commands, the manual explains the use of simple routines to obtain access to the first four effectively. The latter four deal with string manipulation, and whereas the ZX81 does not have these specific commands the way in which it deals with strings is comprehensive, albeit non-standard. It uses a notation called 'slicing' for describing substrings. This can be applied to arbitrary string expressions and takes the general form . . . 'string expression (start TO finish)' so that

```
"ABCDEF" (s TO 5) = "BCDE"
```

and

```
"ABCDEF"(3) = "C"
```

Different as this may be from other common micros it is easily understood and will readily yield the results you would expect from the more usual string commands.

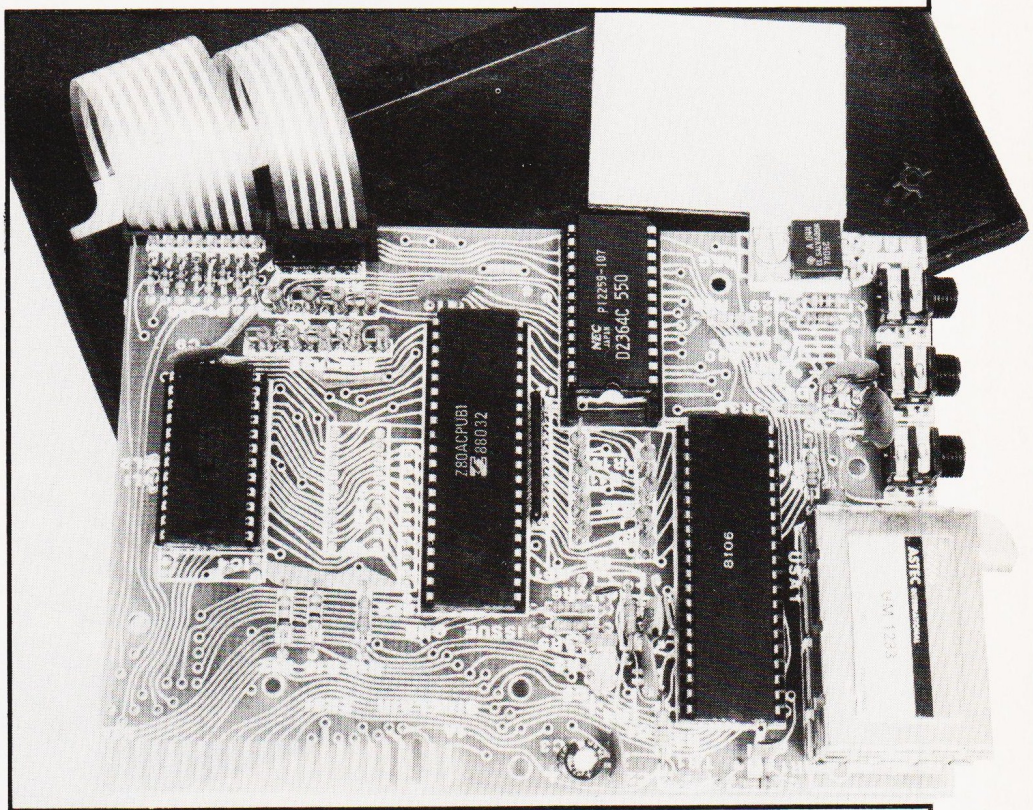
Using It

In use, the ZX81 presents no real lasting problem to operate. If you are new to using a computer then you have probably used a calculator and so the keyboard spacing will not seem all that different. If, on the other hand, you regularly use a typewriter keyboard, you will take a few hours to adapt to the diminutive size of the ZX81: but then those few hours will enable you to become accustomed to the fact that some keys may give up to six different results! One very small but important improvement on the ZX81 is its rubber feet. The ZX80 and ZX81 are both very light in weight, and with its new feet at least the ZX81 does not skate all over the table as you use it!

With the ZX80 some people have reported problems in LOADing and SAVEing programs with certain tape recorders. I have found no problems with either the ZX80 or ZX81, and it is too early to say whether the ZX81 will prove as choosy in its tape partner. The ZX81 will also accept the 16K add-on RAM pack that was marketed for the ZX80. I have tried this combination and, in the limited time it has been in operation, I have had more crashes than I ever had with the ZX80 + 16K RAM. (Subsequent consultations with Sinclair's technical team and a thorough investigation of the hardware revealed that our 16K RAM pack, left over from the ZX80, was the cause of the trouble — not the new '81.) Even with what appears to be a limited memory of 1K, many thousands of ZX80 users will testify to its viability.

All in all, I can recommend the ZX81 to any intending purchaser — it is very good value for money. It does *not* have the facilities one would require for a business machine but anyone wanting to learn *personally* what a computer can do, without initially spending a fair amount of money, should seriously consider one. After all, the ZX81 does not cost much more than the cassette recorder that you will need to buy for some makes of micro.

The only personal drawback to the whole Sinclair ZX episode is that my seven-year-old son tends to look upon the ZX80 and the ZX81 as more his size! He does not have quite the reverence for the ZX's as he does for other micros of the desktop variety. Demand for its use seems to be unending and we often hear "Press NEWLINE, silly!" as he instructs his five-year-old sister in the uses of twentieth-century technology.



The internals of the '81. One very interesting point to note is that the keyboard is a separate unit: the possibility must therefore exist to replace the touch keyboard with a conventional one. All the cunning software controls would appear to be buried in the large chip next to the modulator. There also appears to be a spare IC location between the Z80A and the IC on the left, what will go there no-one will say.

Sinclair's package has certainly improved, this is how the machine arrives. The cassette is one of the new range that was announced at the same time as the '81 was launched.

ZX81 UNVEILED

The '81 is altogether a much nicer package than the '80. The case is better designed, the manual is much better and it feels more like a small computer than a toy. If only this had been the system brought out last year!

SYSTEM/MULTIFUNCTION COMMANDS

BREAK	Halts run and returns to command mode.
CLEAR	Deletes all variables, freeing the space they occupied.
CLS	Clears screen — clears display file.
CONT	Continues STOPped program.
COPY	Sends copy of display to printer.
EDIT	Returns current line (indicated in program list) to bottom of screen for editing.
FAST	Starts fast mode. Display file is displayed only at end of program, while INPUT data is being typed in or during PAUSE.
FUNCTION	Returns alternative keyword set.
GRAPHICS	Returns alternative character set.
LIST	Lists specified line(s) of program on screen.
LLIST	Like LIST but using printer instead of screen.
LOAD	Looks for specified program on tape — loads it and its variables.
LPRINT	Like PRINT but using printer instead of screen.
NEW	Clears memory and awaits new program.
NEWLINE	Enters command as statement.
PAUSE	Stops computing and outputs the display file to the screen for specified time, or until another key is pressed.
RUBOUT	Deletes character to left of cursor.
RUN	Executes current program.
SAVE	Writes specified program to cassette interface. Records program and variables.
SLOW	Puts computer into compute and display mode, in which the display file is displayed continuously.
STOP	Stops a program that is RUNning.

STATEMENTS

ABS	Returns absolute value of specified variable.
ACS	Returns arcosine (in radians).
AND,OR,NOT	Comparative tests.
ASN	Returns arcsine (in radians).
AT	Defines position of next PRINT statement (in screen lines/columns).
ATN	Returns arctangent (in radians).
CHR$	Gives character whose code is specified.
CODE	Gives code of the first character in specified string.
COS	Returns cosine of angle (in radians).
DIM	Dimensions array size.
EXP	Returns exponential of specified number.
FOR	Used in conjunction with TO and NEXT to execute a defined loop.
GOSUB	Jumps to defined subroutine.
GOTO	Jumps to specified program line number.
IF	Conditional test, used in conjunction with THEN followed by specified statement.
INKEY$	Reads keyboard, result is character of next key pressed.
INPUT	Assigns value of keyboard entry to specified variable.
INT	Returns integer part of number (rounded down).
LEN	Returns length of specified string.
LET	Assigns specified value to specified variable.
LN	Returns natural logarithm of a number.
PEEK	Returns value of specified memory location.
PI	π (3.14159265. . . .).
PLOT	Blacks in pixel at specified co-ordinates.
POKE	Places assigned value in specified memory location.
RAND	Sets the seed used to generate the next value of RND.
REM	No effect on program, allows inclusion of text for comments.
RETURN	Returns to main program from subroutine.
SCROLL	Scrolls the display file up one line.
SGN	Returns sign of number.
SIN	Returns sine of angle (in radians).
SQR	Gives square root of number.
STEP	Used with FOR . . . NEXT loops, defining increment between loops.
STR$	Returns string representation of number.
TAB	Defines column in which PRINT statement will begin.
TAN	Returns tangent of angle (in radians).
UNPLOT	Like PLOT, but blanks out a pixel instead of blacking in.
USR	Calls machine code subroutine.
VAL	Evaluates a string as a numerical expression.

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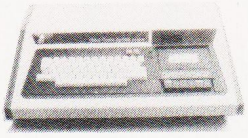

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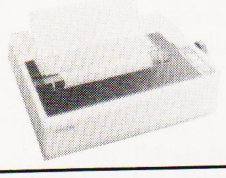

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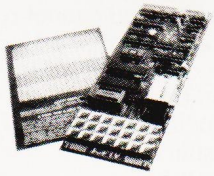

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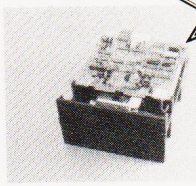

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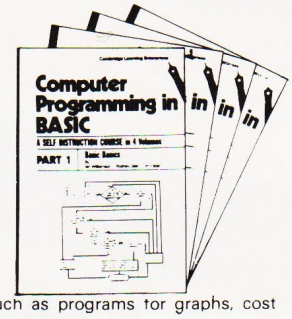

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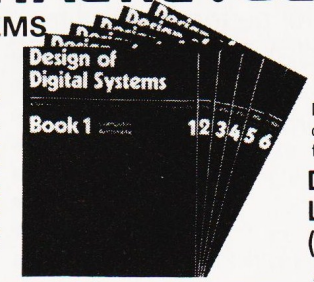

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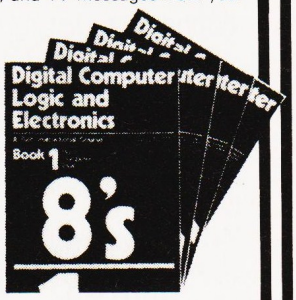

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SINGLE KEY BASIC

P Beckett

Make UK101 programming easier with single key BASIC

This is a machine code program which allows a single keystroke to be used to enter commonly used BASIC keywords such as INPUT, RETURN etc. Using single keys in this way greatly speeds up typing thus making large programs much easier to enter.

The basic requirement in providing any special key functions not already built into the system is to "intercept" the keyboard input before it is passed into the operating system. The simplest way to do this is by changing the contents of the input vector to point to your routine rather than the normal entry point for characters. In this way your software can decide whether a "special" key has been pressed or not. If it hasn't then the character is passed straight into the system in the normal way. If it has then the appropriate BASIC keyword is placed into the input buffer, and displayed on the screen apart from the last character which is passed back to the system as usual.

Program Details

The example given here is for a UK101 (6502 processor) in which the top row of keys (0 to 9), when used in conjunction with the CTRL key, give ten different keywords. One of the objectives was to keep the program size to a minimum so that an unused piece of RAM in the UK101 between 0222 and 02FA could hold the entire program.

In fact sufficient space remains for users of the program to extend the data table to give more special keys if required. The format of entries in this table is:

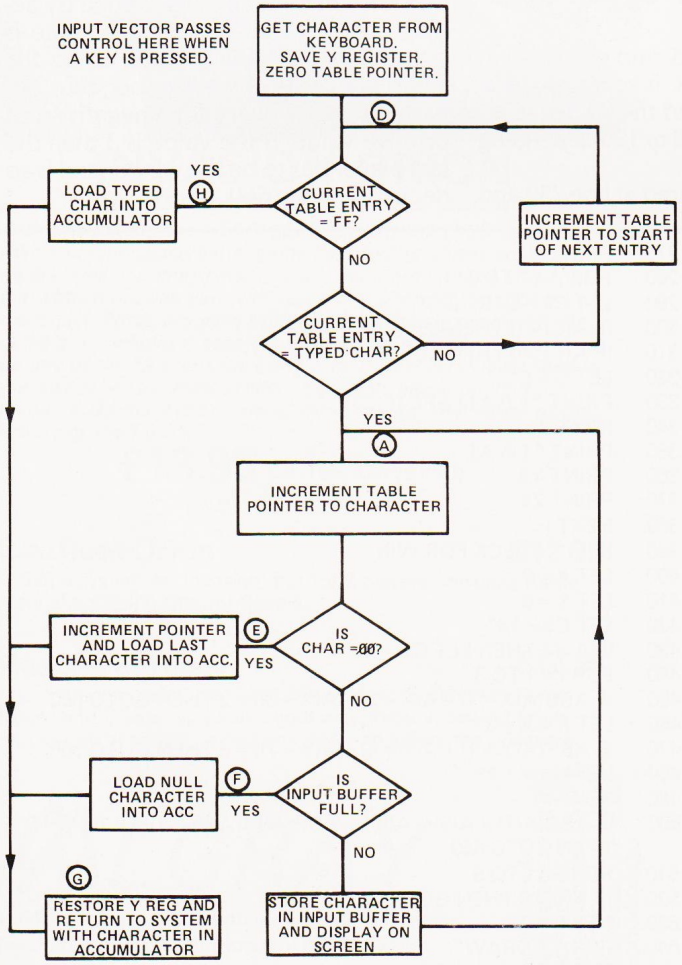
ASCII KEY CODE
1st. CHARACTER
2nd. CHARACTER

LAST CHARACTER
NEXT ASCII KEY CODE or FF
(if end of table)

The logic diagram (Fig. 1.) below shows the way in which this table is searched for a match.

The input vector can be changed by POKE 536,34 : POKE 537,2 to transfer control to the routine. A "warmstart" will put the vector back to normal and by-pass the routine. The comments in the assembler listing indicate the action of any UK101 system routines which are used.

A convenient means of loading the machine code is to run the BASIC Loader Program which is also listed. The POKE commands required to activate the special keys are included and the loader will "self destruct" after running.



Program Listing

```
63000 REM**SPECIAL KEYS LOADER
63001 DATA 32, 186, 255, 132, 224, 160, 0, 133, 225, 185
63002 DATA 102, 2, 201, 255, 240, 45, 197, 225, 240, 12
63003 DATA 200, 185, 102, 2, 240, 2, 208, 248, 200, 200
63004 DATA 208, 233, 200, 185, 102, 2, 240, 13, 224, 71
63005 DATA 16, 15, 157, 19, 0, 32, 105, 255, 232, 208, 237
63006 DATA 200, 185, 102, 2, 208, 6, 169, 0, 240, 2, 165
63007 DATA 225, 164, 224, 76, 153, 163, 241, 68, 65, 84
63008 DATA 0, 65, 242, 80, 79, 75, 0, 69, 243, 80, 69, 69, 75
63009 DATA 0, 40, 244, 78, 69, 88, 0, 84, 245, 71, 79, 84, 0
63010 DATA 79, 246, 71, 79, 83, 85, 0, 66, 247, 82, 69, 84
63011 DATA 85, 82, 0, 78, 248, 84, 72, 69, 0, 78, 249, 73, 78
63012 DATA 80, 85, 0, 84, 240, 88, 61, 85, 83, 82, 40, 88, 0, 41, 255
63013 FOR I = 546 TO 683
63014 READ X : POKE I,X
63015 NEXT
63016 POKE 536,34 : POKE 537,2
63017 NEW
```

```
0222  20 BA FF     JSR $FFBA      /GET CHARACTER FROM
                                   KBD INTO ACC.
      84 E0        STY $E0        /SAVE Y REG
      A0 00        LDY #$00
      85 E1        STA $E1        /PUT TYPED CHAR IN E1
      B9 66 02 D:  LDA TABLE,Y    /LOAD ENTRY FROM
                                   TABLE
      C9 FF        CMP #$FF       /IS IT THE END
      F0 2D        BEQ H          /YES – SPECIAL CHAR
                                   WASN'T TYPED
      C5 E1        CMP $E1        /NO – DOES IT MATCH
                                   TYPED CHAR?
      F0 0C        BEQ A          /YES
      C8         C: INY           /NO, INCREMENT POINTER
```

```
B9 66 02      LDA TABLE,Y      /LOAD NEXT TABLE
                                ENTRY
F0 02         BEQ B            /GO TO B IF = 0
D0 F8         BNE C            /NO LOOP BACK
C8         B: INY              /INCREMENT POINTER TO
                                NEXT
C8            INY              /KEYWORD ENTRY IN
                                TABLE
D0 E9         BNE D            /AND BRANCH BACK
                                (ALWAYS)
C8         A: INY              /MATCH FOUND-INCR
                                POINTER TO KEYWORD
B9 66 02      LDA TABLE,Y      /CHARACTER AND LOAD
                                INTO ACC.
F0 0D         BEQ E            /IF CHAR = 0 GO TO E
E0 46         CPX #$46         /CHECK IF INPUT BUFFER
                                FULL
10 0F         BPL F            /YES – GO TO F
9D 13 00      STA 13,X         /NO PUT CHAR INTO
                                BUFFER
20 69 FF      JSR $FF69        /AND DISPLAY ON
                                SCREEN
E8            INX              /INCR TO NEXT INPUT
                                BUFFER POSN
D0 ED         BNE A            /BRANCH ALWAYS
C8         E: INY              /INC POINTER TO LAST
                                CHAR OF KEYWD
B9 66 02      LDA TABLE,Y      /LOAD LAST CHARACTER
D0 06         BNE G            /BRANCH ALWAYS
A9 00      F: LDA #$00         /INPUT BUFFER FULL SO
                                SEND NULL
F0 02         BEQ G            /BACK TO SYSTEM
A5 E1      H: LDA $E1          /LOAD ACC WITH TYPED
                                CHAR
A4 E0      G: LDY $E0          /RESTORE Y REG
4C 99 A3      JMP $A399        /RETURN TO SYSTEM
                                WITH CHAR IN ACC
TABLE=0266                     /THE DATA BLOCK IS AS
                                FOLLOWS
                               /AND PROVIDES TEN
                                KEYWORDS
                               /WHEN THE CTRL KEY IS
                                USED
                               /WITH THE 0-9 KEYS.
0266 F1 44 41 54 00 41         /CTRL 1 = 'DATA'
     F2 50 4F 4B 00 45         /CTRL 2 = 'POKE'
     F3 50 45 45 4B 00 28      /CTRL 3 = 'PEEK('
     F4 4E 45 58 00 54         /CTRL 4 = 'NEXT'
     F5 47 4F 54 00 4F         /CTRL 5 = 'GOTO'
     F6 47 4F 53 55 00 42      /CTRL 6 = 'GOSUB'
     F7 52 45 54 55 52 00 4E   /CTRL 7 = 'RETURN'
     F8 54 48 45 00 4E         /CTRL 8 = 'THEN'
     F9 49 4E 50 55 00 54      /CTRL 9 = 'INPUT'
     F0 58 3D 55 53 52 28 58 00 29
     FF                        /CTRL 0 = 'X=USR(X)'
                               /END OF DATA BLOCK
```

MINI OXO

Colin Chatfield

Noughts and crosses in 1K on a ZX80

Following the recent OXO game (Computing Today, February 1981) here is a 1K version for the ZX80. The computer chooses the first player to move at random in line 50. A grid of numbers from 1 to 9 represents the play positions on the board, and is printed at lines 240 to 380. An 'X' is represented in array A(9) by a +1 and the 'O' by a −1 and stored by lines 180 or 190 depending on whose turn it is.

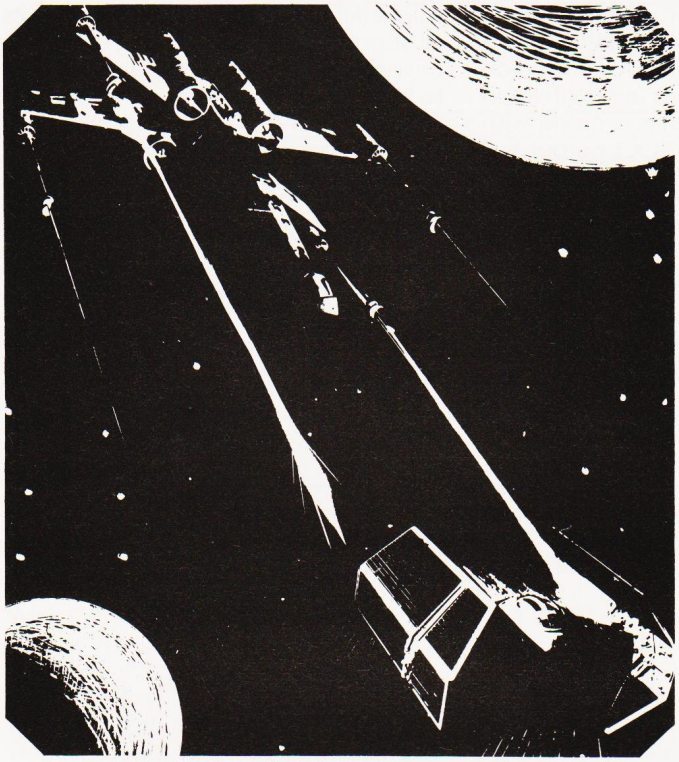
The screen is cleared at line 230 and a check is made to see if the position for the move has already been used before at line 170. The board is then printed out. A check is then made to see if a winning horizontal, vertical or diagonal combination has been made. This is done by adding up the rows to see if the value is either 3 or −3 and is done using the ABSolute value of the number, thus not having to run a check for a negative and positive value. If the value is 3 then the last player has to be the winner and is so declared at line 560.

Program Listing

```
10   LET Z$="[13^A]"
20   LET Y$="[^A][3 SPC][^A][3 SPC][^A]
     [3 SPC][^A]"
30   PRINT "OXO"
40   DIM A(9)
50   LET A=RND(2)
60   IF A=1 THEN GOTO 90
70   PRINT "O";
80   GOTO 100
90   PRINT "X";
100  PRINT "ENTER 1 TO 9"
110  PRINT
120  GOTO 240
130  PRINT
140  GOTO 180
150  PRINT "AGAIN"
160  INPUT D
170  IF D<1 OR D>9 OR NOT A(D)=0 THEN GOTO 150
180  LET A(D)=1
190  IF A=2 THEN LET A(D)=-1
200  LET A=A+1
210  IF A=2 THEN LET A=1
220  REM**DISPLAY BOARD
230  CLS
240  LET C=1
250  PRINT Z$
260  FOR I=1 TO 3
270  PRINT Y$
280  FOR J=1 TO 3
290  LET C$=STR$(C)
300  IF A(C)<0 THEN LET C$="O"
310  IF A(C)>0 THEN LET C$="X"
320  LET C=C+1
330  PRINT "[^A][SPC]";C$;" ";
340  NEXT J
350  PRINT "[^A]
360  PRINT Y$
370  PRINT Z$
380  NEXT I
390  REM**CHECK FOR WIN
400  LET X=0
410  LET Y=0
420  LET C$="X"
430  IF A=1 THEN LET C$="O"
440  FOR I=1 TO 3
450  IF ABS(A(X+1)+A(X+2)+A(X+3))=3 THEN GOTO 560
460  LET X=X+3
470  IF ABS(A(Y+1)+A(Y+4)+A(Y+7))=3 THEN GOTO 560
480  LET Y=Y+1
490  NEXT I
500  IF ABS(A(1)+A(5)+A(9))=3 OR ABS(A(3)+A(5)+A(7))=3
     THEN GOTO 560
510  FOR I=1 TO 9
520  IF A(I)=0 THEN GOTO 160
530  NEXT I
540  PRINT "DRAW"
550  STOP
560  PRINT C$;" WINS"
```

TRS-80 SOFTWARE

STARQUEST



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O S Bird

Gain access to the outside world with this adaptable project. Designed by Ferranti Electronics, it's suitable for use on any VIA based micro.

The circuit was designed to interface a dual-axis joystick control and is based on the Ferranti ZN427 IC. This is an eight-bit Analogue to Digital Converter (ADC), with tri-state outputs to permit direct connection to an eight-bit data bus. The IC operates on the successive approximation principle and contains all the logic and circuit elements, including an on-chip reference required to perform an eight-bit accurate A to D conversion.

A two-channel analogue interface circuit suitable for direct connection to the PET Parallel User Port (J2) is shown in Fig.1.

Circuit Operation

Operation of the circuit is as follows. The eight Port A lines from the 6522 VIA, which are programmed as inputs, are connected to the data outputs of the two ADC's to form a common eight-bit bus. The ADC's are configured in a continuous conversion mode with the End Of Convert (EOC) output fed back via a 'D' type latch to generate a start strobe on the Start Convert (SC) input. The CB2 line which is programmed in the 'manual output mode' is used to alternately gate the EOC outputs of each ADC.

Assume initially that CB2 is at a logic '1'. In this condition ADC1 will be continuouly cycling with its data outputs in the high impedance state and ADC2 will be held, with valid data latched on its data outputs. These will be enabled to drive the eight-bit bus. Programming CB2 to logic '0' will stop the cycling mode on ADC1 at the end of its current conversion cycle and enable its data outputs.

Simultaneously, the outputs of ADC2 will be disabled and it will be switched to continuous cycling. After a delay of at least eight clock periods which allows the current conversion cycle of ADC1 to end, the converted digital value can be read by means of a PEEK in-

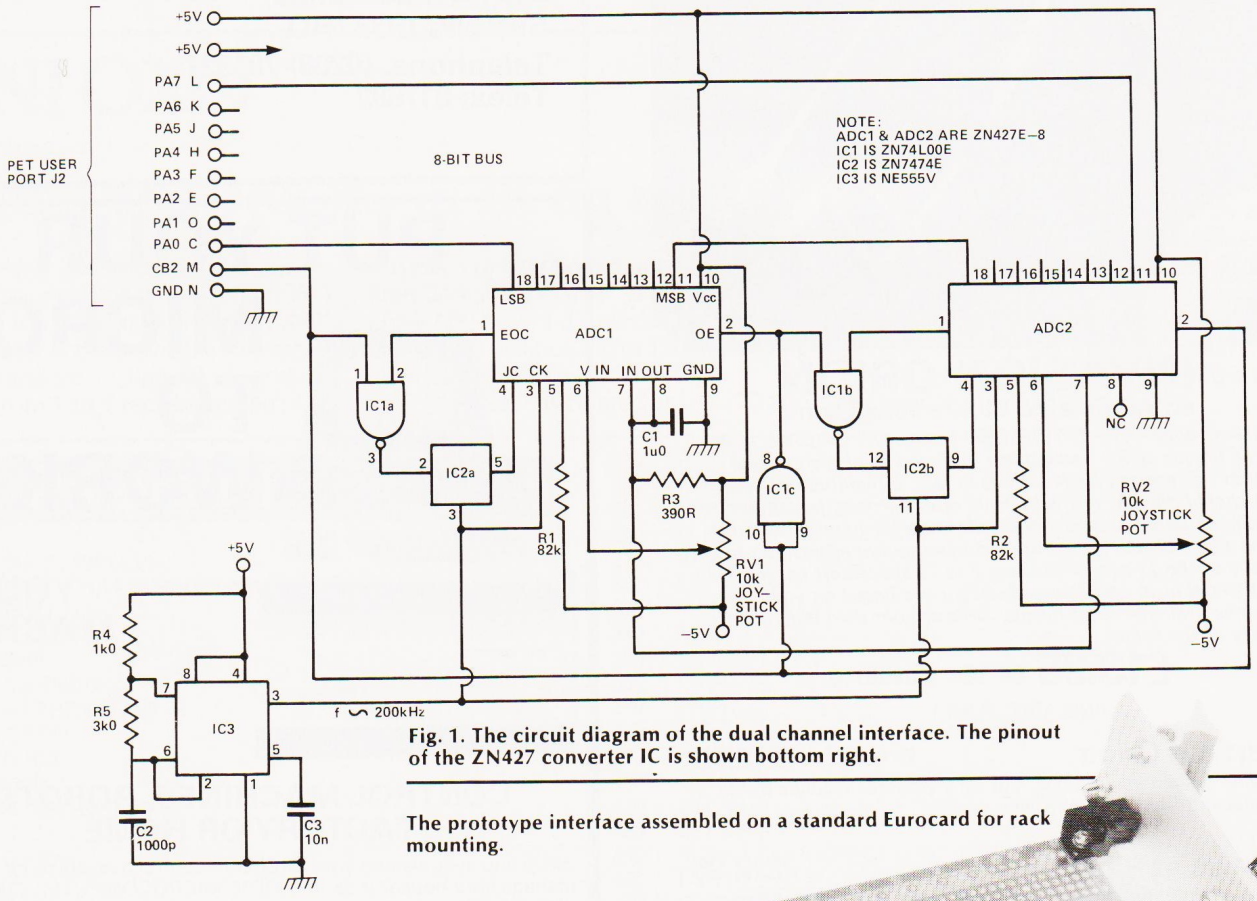
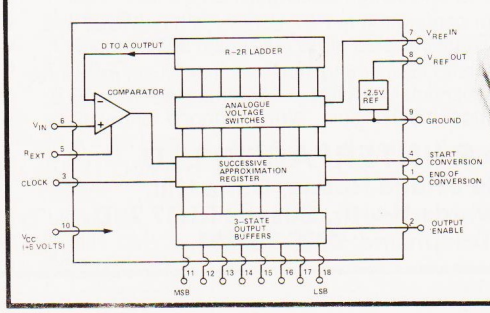
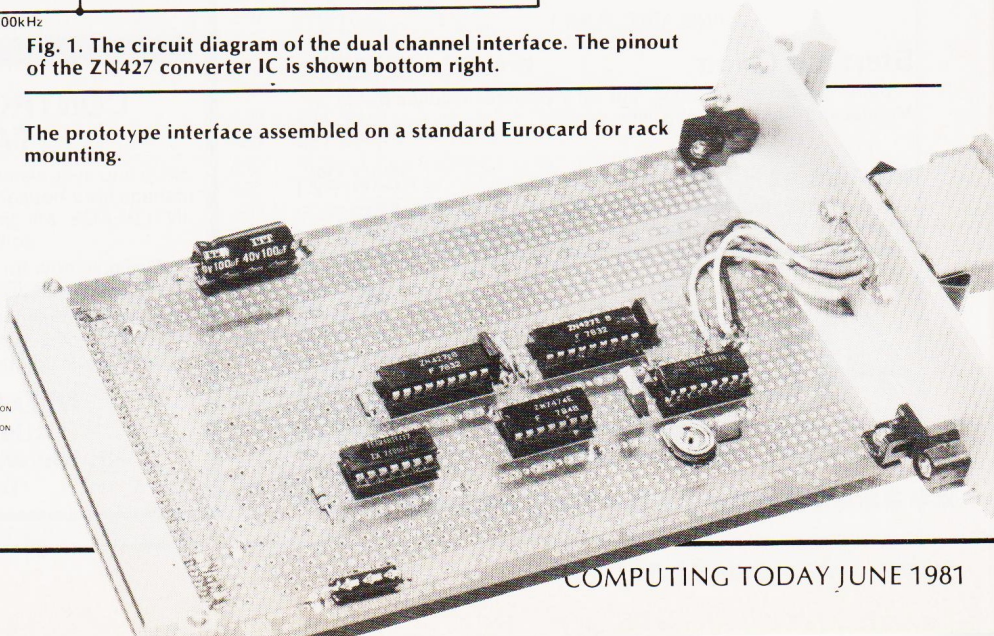


Fig. 1. The circuit diagram of the dual channel interface. The pinout of the ZN427 converter IC is shown bottom right.



The prototype interface assembled on a standard Eurocard for rack mounting.



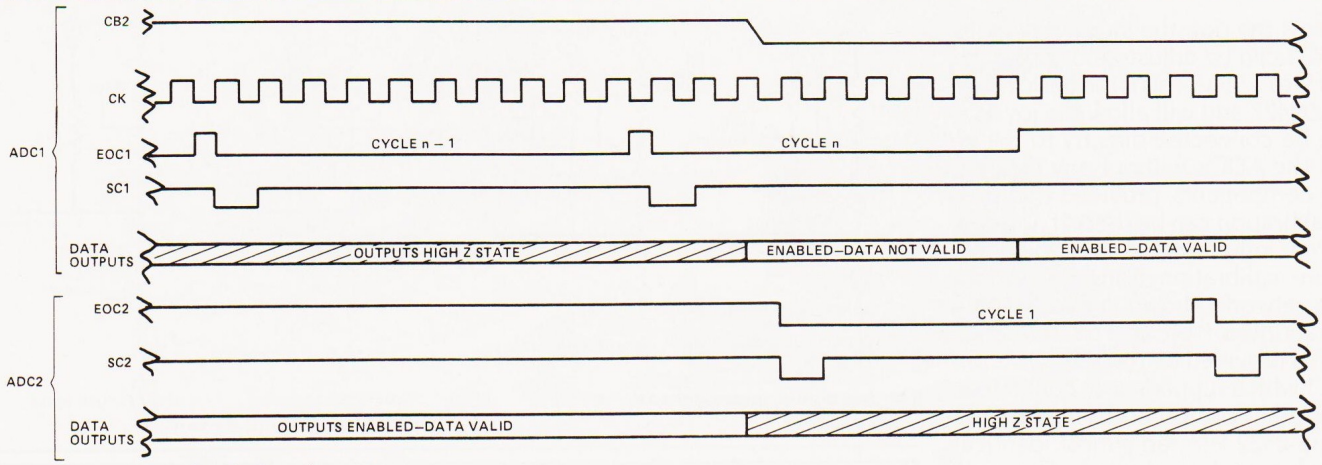


Fig. 2. Timing diagram for the interface unit.

struction to Port A input register. Setting CB2 back to logic 1 switches ADC1 back to cycling, disables its outputs, enables ADC2 outputs and stops ADC2 at the end of its cycle. Hence the function of CB2 is to switch each ADC 'on' alternately and to enable the value of the last conversion to be read after a short delay. Typical waveforms illustrating this operation are shown in Fig. 2.

Program Control

The control program can either be written in BASIC for normal operation with the joystick or in machine code if fast sampling of the input data (greater than about 10 bytes/sec) is required, in which case an additional program delay may be necessary, depending on clock frequency, between the CB2 output and the Port A Load instructions. In BASIC no additional delay is necessary for clock frequencies greater than 500 Hz.

The simple program below provides an example of the statements used to control the analogue interface. The ADC's are read alternately and the value displayed on the PET's screen in decimal.

```
10    REM**JOYSTICK2
20    REM**3.10.80 OSB
30    PRINT "[CLS]"
40    REM**INITIALISE VIA
50    POKE 59459,0
60    POKE 59467,PEEK(59467) AND 226
70    REM**TOGGLE CB2 AND READ ADCS
80    POKE 59468,PEEK(59468) AND 31 OR 192
90    D1 = PEEK(59471)
100   POKE 59468,PEEK(59468) OR 224
110   D2 = PEEK(59471)
120   REM**DISPLAY RESULTS
130   PRINT"[HOM]" D1" [CL] [2 SPC]"
140   PRINT
150   PRINT D2 "[CL] [2 SPC]"
160   GOTO 80
```

Line 50 sets the Port A Data Direction Register to all zeros, which defines the eight Port A lines as inputs. Line 60 sets bits 0,2,3, and 4 of the Auxiliary Control Register to logic 0, which disables the latching mode on Port A and disables the shift register. Line 80 sets bits 5,6,7 of the Peripheral Control Register (PCR) to 011 which sets CB2 line to a logic 0 level. Line 100 sets bits 5,6,7 of the PCR to all ones thereby driving CB2 line to a logic 1 level.

Lines 90 and 110 now read the data present on Port A pins (in the non-handshake mode).

Hardware Connection

Supplies required are ±5 V, although by changing the resistor on pin 5 of the ADC's a negative supply of up to -30 V is permissible. With a standard joystick control the sweep angle is only of the order of ± 25° of the potentiometer's 270° travel and hence with ±

The joystick unit connected to a Commodore PET.

Parts List

Resistors All ¼ W 5%

R1, 2	82k
R3	390R
R4	1k
R5	3k

Potentiometers

RV1,2	10k joystick pot

Capacitors

C1	1u 16V electrolytic
C2	1000p
C3	10n

Semiconductors

ADC1,2	ZN427E-8
IC1	74L00
IC2	7474
IC3	NE555

5 V across the pot, the input voltage to the ADC's can be adjusted to within the range 0 V to 2.55 V. This is the basic range of the ZN427 and will allow the joystick pots to be connected directly to the inputs of the ADC's without any external scaling components, provided that software calibration can be used. If, instead, a different input range is wanted, then a hardware calibration using the simple resistor networks shown in Figs. 3 and 4 can be adopted. Note that the reference voltage is provided by the Vref OUT pin of ADC1 which supplies both converters.

For other computers using the 6502 CPU and 6522 VIA, an almost identical approach can be adopted. The only change required is to the address locations and these are shown in Table 1. Computers using 8080 and Z80 CPU's with attendant PIO/PIA chips can also use the circuit but it will have to be handled directly rather than using memory mapping.

Control programs written in machine code are the subject of this month's '6502 Programming Course'(to be found elsewhere in this issue).

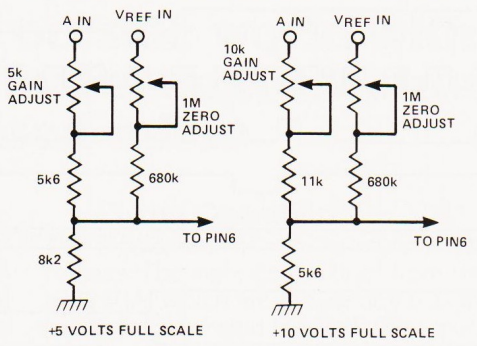


Fig. 3. Unipolar input network.

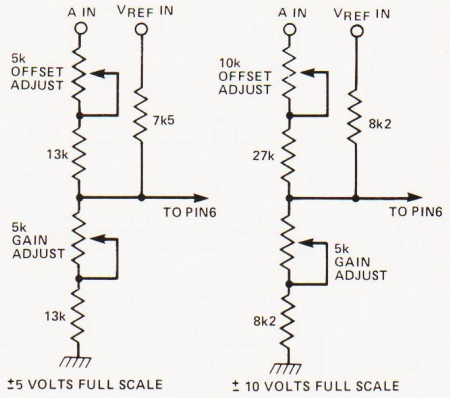
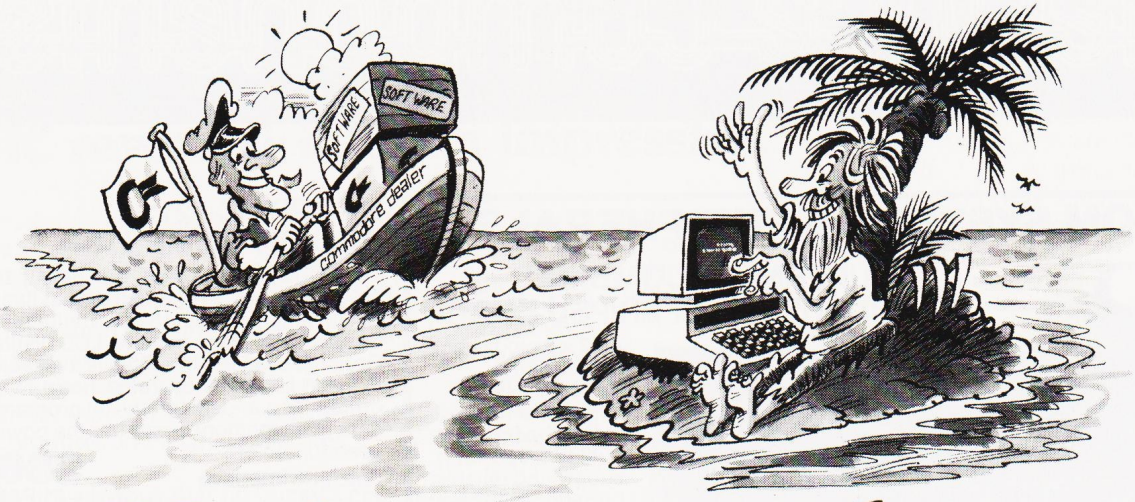


Fig. 4. Bipolar input network.

COMPUTER	PORT A ADDRESS		PORT B ADDRESS		CONTROL REGISTER ADDRESS FOR PORT A		CONTROL REGISTER ADDRESS FOR PORT B		BYTE TO SET PORTS INTO OUTPUT MODE		COMMENTS
	HEX	DEC	HEX	DEC	HEX	DEC	HEX	DEC	HEX	DEC	
ACORN ATOM	B801	47105	B800	47104	B803	47107	B802	47106	FF	255	REMOVE PRINTER DRIVE ROUTINE BY !#208 = !#208 + 3 TURN OFF HANDSHAKE WITH ?#B80C = 0
ROCKWELL AIM–65	A00F	40975	A000	40960	A003	40963	A002	40962	FF	255	
COMMODORE PET	E84F	59471	E822	59426	E843	59459	IEEE-488 PORT SEE TEXT		FF for PORT A	255	PORT A IS FROM THE VIA AND IS STRAIGHT–FORWARD TO USE. PORT B IS FROM NO.2 PIA AND IS SET UP AS THE IEEE-488 PORT
TANGERINE MICRON & MICROTAN –65 WITH TANEX EXPANSION	BFC1	49089	BFC0	49088	BFC3	49091	BFC2	49090	FF	255	THESE MACHINES HAVE TWO VIAS, AND THUS 32 OUTPUT LINES. WITH TWO INTERFACE BOARDS THIS COULD BE INCREASED TO 128!
	BFE1	49121	BFE0	49120	BFE3	49123	BFE2	49122	FF	255	

Table 1. The VIA addresses of some popular microcomputers.



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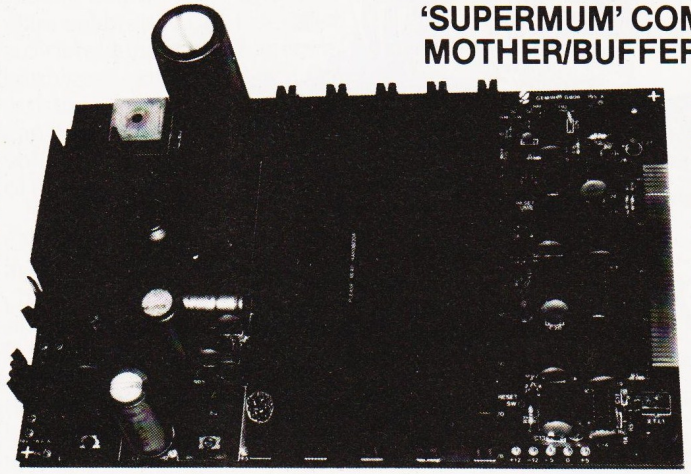

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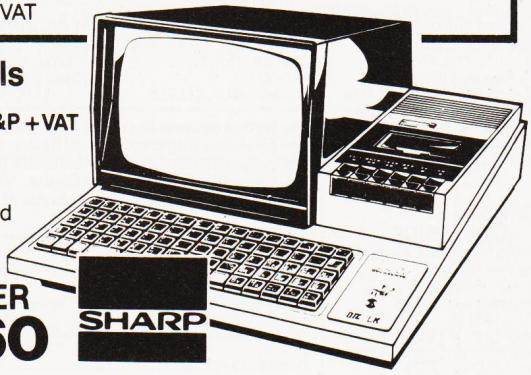

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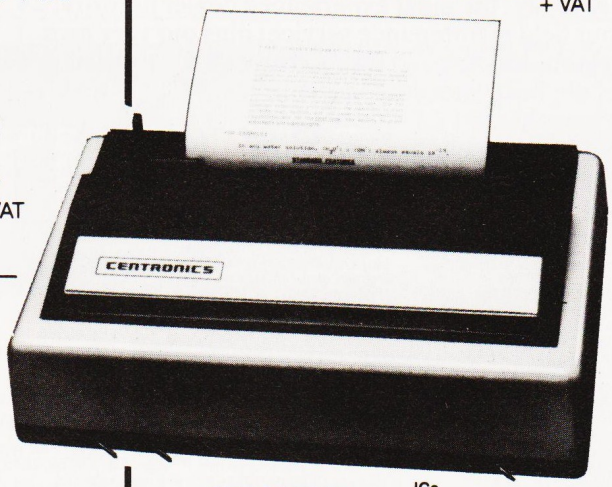

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The specification for the BBC's BASIC revealed; it looks impressive.

One of the major criticisms that has been levelled against the BBC's choice of the Acorn designed machine for use in their series is that they have a 'non-standard' BASIC. We have obtained a full specification of the Interpreter that will be supplied with the new computer and its main features are listed below.

Whilst it is obvious that no 'dialect' of an established language can be regarded as perfect an inspection of the commands and features available will reveal that a great deal of similarity exists between it and many other variants that are around.

The overall feeling produced by this document, of which we have only been able to reproduce a part, is that a very considerable amount of care has been taken to ensure its general compatability. The provision of such features as IF... THEN...ELSE and others more than outweigh any slight inconsistencies. We hope to test out a version of the new Interpreter very soon and will bring you a full report on its performance.

The BASIC interpreter works through one of three file systems: a cassette file system, a disc file system and a network file system. The user can easily move between file systems and can pass complicated commands direct to the file system while in BASIC or any other language or environment.

It will also contain an assembler, as in the ATOM computer, except that different characters will be used for hexadecimal notation and for 'immediate'. A screen editor is incorporated.

Variables

Variable names may be of unlimited length and all characters are significant. Variable names must start with a letter. They can only contain the characters A..Z, a..z, 0..9 and underline. Embedded keywords are allowed. Upper and lower case variables of the same name are different. The following types of variables are allowed:

A	real numeric
A%	integer numeric
A$	string
FNA	numeric function
FN$A	string function
PROCA	procedure

The variables A%..Z% are regarded as special in that they are not cleared by the commands or statements RUN, CHAIN and CLEAR. In addition A%, X% and Y% have special functions in CALL and USR routines.

The variables A%..Z% are called 'static variables'. All other variables are called 'dynamic variables'.

Real variables have a range of $+-10^{38}$ and functions evaluate to nine significant figure accuracy. Internally every real number is stored in 40 bits. Integer variables are stored in 32 bits and thus have a range of about +− 2000 million. String variables may contain up to 255 characters. All arrays must be dimensioned before use.

All statements and functions can also be used as commands.

The Command Set

ABS A function giving the absolute value of its argument.

ACS A function giving the arcosine of its argument in radians.

ADS A function which returns the last known value of analogue to digital channel N.

AND A binary operation which carries out the bitwise AND between its two arguments as 32 bit integers.

ASC A function returning the ASCII character value of the first character of the argument string. If the string is null then zero will be returned.

ASN A function giving the arcsine of its argument in radians.

ATN A function giving the arctangent of its argument in radians.

AUTO A command allowing the user to enter lines without first typing in the number of the line. AUTO mode is left with <ESC> or with a line starting with EOT (ASCII code 4).

BEEP X,Y A statement causing a tone to be added to the BEEP queue for generation. X = half-period, Y = duration.

BGET # A statement which gets a byte (X) from the file opened on channel number N.

BPUT # A statement which puts a byte to the file whose channel number is the first argument. The second argument's least significant byte is sent.

CALL A statement to call a piece of machine code. Parameters are passed in a 'Parameter Block' the address of which is stored in a fixed location near the start of the BASIC interpreter. The number of parameters passed may be zero.

CHAIN A statement which will load and run the program whose name is specified in the argument. All variables except A% to Z% are cleared.

CHR$ A string function whose value is a string of length 1 containing the ASCII character specified by the least significant byte of the numeric argument.

CLEAR A statement which clears all variables to zero (except A%..Z%) and empties all strings.

CLOSE # A statement used to CLOSE a sequential file.

CLS Clears the screen to the current background colour, moves the text cursor to top left (0,0) and the graphics pointer and origin to bottom left (0,0).

COLOUR A statement setting the current foreground colour mode for the 'soft' displays. (See GRAPHICS for description of soft displays.)

COS A function giving the cosine of its radian argument.

COUNT A function returning the number of characters printed since the last new line. See also POS.

DATA String data not enclosed in quotes must not contain embedded keywords.

DEG A function which converts radians to degrees.

DEF A program statement which must precede declaration of a user function FN.

DELETE A command for line deletion.

DIM A statement which dimensions arrays.

DRAW X,Y Draw a line to X,Y in the current foreground colour. DRAW X,Y is equivalent to PLOT 5,X,Y.

ERL A function returning the line number of the line where the last error occurred.

ERR Returns the error number of the last error which occurred.

EVAL A function which applies the interpreter's expression evaluation program to the characters held in the argument string.

EXP A function returning e to the power of its argument.

EXT # A function which returns the length, in bytes, of the file open on channel N.

FALSE A function returning 0.

FN A reserved word used at the start of all user defined string functions.

DEF A reserved word used at the start of all user defined procedures.

FOR A statement initialising FOR ... NEXT loop. Always executes at least once.

GET Will wait for a character from the current input stream and return the ASCII value.

GRAPHICS A statement which clears the screen and initiates operation in the specified graphics mode, Mode, in the range 0-7 and with optional coloured background, colour, in the range 0-15.

0. 640x256 2 colour graphics and 80x32 text (20K)
1. 320x256 4 colour graphics and 80x32 text (20K)
2. 160x256 16 colour graphics and 20x32 text (20K)
3. 80x25 2 colour text (16K)
4. 320x256 2 colour graphics and 40x32 text (10K)
5. 160x256 4 colour graphics and 20x32 text (10K)
6. 40x25 2 colour text (8K)
7. 40x25 teletext (1K)

Graphics modes 0 to 3 will not be available on the unexpanded machine since they require more than 16K of memory. Graphics modes 0 to 6 are referred to as SOFT displays since in these modes the character set is entirely user defined. For text characters the origin (0,0) is at the top left of the screen. The screen is 40 or 80 characters wide and 25 or 32 lines high. For graphics commands the origin is at the bottom left. Regardless of the graphics mode the screen is addressed as 640 horizontal points and 512 vertical points. Internal scaling is applied to suit the selected graphics mode.

HIMEM HIMEM contains the address of the first free byte that BASIC does not use. This cannot be used inside a FOR ... NEXT, REPEAT ... UNTIL, WHILE ... ENDWHILE structure, a function or a procedure. The user is cautioned to use this facility with care!

HTN A function which returns the hyperbolic tangent of its argument.

INKEY Tests the keyboard to see if a key is pressed. The function returns −1 if no key is pressed, or the ASCII value of the key pressed.

INPUT Default input is from keyboard, prompts may be embedded. An invalid reply produces a standard error message and then issues a question mark. This condition can be trapped with ON ERROR GOTO.

INPUT LINE Accepts the whole of the INPUT including commas, inverted commas and leading spaces.

INPUT # A statement which reads data in internal format from a file and places the data in the stated variables.

INSTR A string manipulation function. Returns the position of one string within another. Returns 0 if not found.

INT INT is a function truncating a real number to the lower integer.

LEFT$ A string manipulation function returning the specified left-hand portion of a string.

LEN Returns the length of a specified string.

LN A function giving the natural log of the specified variable.

LOCAL Declares variables for local use. May be used in functions and procedures.

LOG A function giving the LOG to base 10 of the specified variable.

LOMEM Gives the first location in memory above which all dynamic variables are stored. The default is TOP — the first free address after the end of the user program. Moving LOMEM causes loss of all dynamic variables.

LVAR Lists all variables and their current values (except arrays).

MID$ Returns the specified middle portion of a string.

MOD A binary operation giving the binary unsigned remainder of an integer division.

MOVE Move the graphics pointer to the specified co-ordinates.

NEW Erases the current program.

NOT Logical inversion.

OLD Recovers the file deleted by NEW.

ON Suppresses error messages and passes control to specified line.

OPENIN # A function which returns the channel number allocated to the file. The file is opened for input and updating (random access).

OPEN OUT # A function which returns the channel number of the file which is to be opened for output.

OR Bitwise logical OR.

ORIGIN Moves the effective origin of all graphics commands to specified co-ordinates.

PAGE The starting 'page' of the current program where 'page' refers to 256 bytes. Programs always start on a 'page' boundary.

PLOT Plots to the point at specified co-ordinates with the attribute K.

POINT Returns the colour of specified point on the screen, or −1 if the point is off the screen.

POS The horizontal position of the cursor. The left position is 39 or 79.

PRINT # Writes data in internal format to the file opened as channel N. All numerics are written as five bytes and all strings as the bytes in the string plus <CR>.

PROC A reserved word used at the start of all user defined procedures, which may then be called by name. Any number of parameters, including zero, may be passed.

PTR # PTR # moves a byte pointer to a file opened on named channel and thus enables random access.

RAS Converts degrees to radians.

RANDOMIZE Re-initialises the random number generator.

READ Used in conjunction with DATA.

RENUMBER Command for renumbering program lines.

REPEAT Repeats a program segment UNTIL a condition is met.

REPORT Prints the error message associated with the last error.

RESTORE Resets the DATA pointer to the specified line.

RESUME Used after ON ERROR GOTO to retry the line which caused the error. This cannot be used inside a FOR ... NEXT, REPEAT ...UNTIL, WHILE ... ENDWHILE structure, a function or a procedure. An alternative exit would be with GOTO.

**RIGHT$** As LEFT$ but on the right-hand portion of the specified string.

RND Random number function.

SGN Returns −1 for a negative number, 0 for zero and +1 for a positive number.

SIN Returns the sine of a specified variable.

SGR Returns the square root of a specified variable.

STOP Stops execution of the program and prints STOP AT LINE N.

STR$ Produces a string representing the specified number.

STRING$ Produces a multiple string concatenation.

TAN Returns the tangent of a specified variable.

TIME The elapsed time in centi-seconds.

TOP The first free location after the end of the current program. Thus the length of the program is given by TOP-PAGE*256.

TRACE Program debugging aid.

TRUE PRINT TRUE would print −1.

USR Machine code subroutine call from BASIC.

VAL Returns numeric value of a string.

VPOS Returns the vertical position of the cursor. Line 0 is the top line on the display, line 24 or 31 is the bottom line.

WIDTH Sets terminal width.

XOR A binary operation which carries out the bitwise exclusive OR between its two arguments as 32 bit integers.

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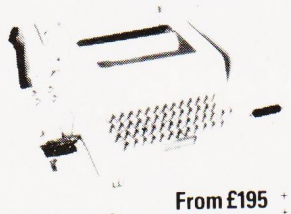

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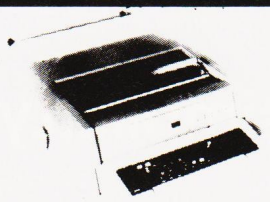

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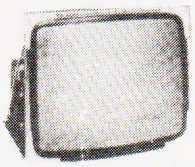

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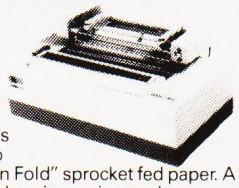

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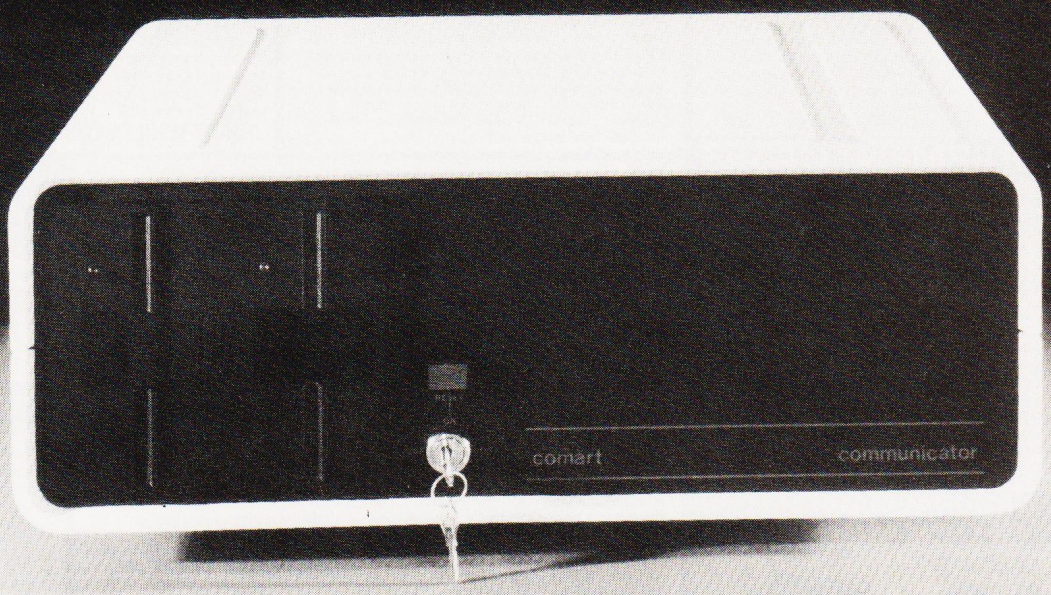

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6502 PROGRAMMING COURSE

A P Stephenson

In our continuing series for owners of 6502 based micros we look at how to program for communication outside the computer.

Most of the programs we see in magazines are 'non-peripheral'. Although the keyboard and the video display are strictly 'peripherals', due to the magic of the BASIC interpreter we are able to use them without effort. This may give one the false impression that it is easy to control external devices. This is not so. Even an apparently simple task like reading a keyboard is fraught with danger. For instance, has any key been pressed at all? Don't say "what about GET K?". This is cheating because the keyword GET is part of BASIC and triggers off several machine code steps which we are unaware of. Now, suppose a key is pressed and we know how to detect this, there remains the problem of finding out *which* key. Very few keyboards carry hardware decoding logic. They are passive networks with simple switches at the intersection of x and y coordinate wires. Decoding must be done with software... machine code.

The most widely accepted code for character input is ASCII (American Standard Code for Information Interchange).

Instead of accepting the usual ASCII code to Hex conversion tables, it is more satisfying to penetrate the logic behind the code. It is based on the seven bit plan shown in Fig. 1.

It is not intended that the above should be used to work out every code when you need it... far easier to use tables, but there are occasions when a knowledge of the bit pattern can be very helpful. As you may notice, the ASCII code only requires seven bits, allowing a theoretical limit of 128 different combinations which has always been considered adequate for conventional data processing. The eighth bit (bit 7) is either set to '0' or in some cases used as an error detection bit, known as 'parity'. However, in the PET there are, in addition to the normal ASCII characters, a motley collection of 'graphics' which require some fiddling about with the code. The eighth bit is used to produce the reverse characters for the screen display. An added complication is the existence of a hybrid code when using POKE funtions. The confusion which arises because of the difference between ASCII and POKE numbers is the price to pay for the luxury of 256 different screen characters.

To appreciate the advantage of high level languages and the enormous amount of work entailed in writing the software in machine code, consider the problem of the 'input routine' from a keyboard. Not only must the key be read, it is important to store numbers in a different memory block to letters. Thus it requires in the first place, a routine to separate them. Having separated them it is necessary to erase those parts of the ASCII code which have no numerical significance when it is a number. Thus, if the number 5 is keyed in as an ASCII character, it arrives disguised as 00110101. Only the four right hand bits have numerical significance, the remainder are embarrassing hangers-on once it has been recognised. These must be stripped off in some way. This provides a good chance to show off the virtues of the AND instruction. Suppose we have a number (hidden within the ASCII code) resting in address 0350. This will tidy up the mess,

```
LDA 0350    Load into Acc
ANDIM OF    Erase the four left bits
STA 0350    Put it back again
```

The User Port

It is probable that very few PET owners take much of an interest in the various edge connectors which stick out from the back and side apart from the tape cassette socket. Most people find the machine provides sufficient scope for mental exercises without the need to 'tamper' with the external pins. Many would like to but quite naturally are a little apprehensive in case their experiments could backfire into the PET and cause damage. However, there is no reason why a few test programs shouldn't be tried on a very simple hook-up board connected to the USER PORT. We can then use simple switches to simulate inputs and LEDs to indicate output states. Consulting the Manual and 6502 hardware book should reveal the following initial information:

1. The port is a 24 pin edge connector but the BOTTOM 12 only are intended for PET owners; the top pins are for service engineers and, unless you have electronic knowledge, are better left alone.

2. The pin identifications of the bottom twelve are shown in Fig. 2.

The lines on the user port originate from a specialised input/output chip called a VIA which stands for Versatile Interface Adaptor. It is known by the type number 6522 and is one of the support chips to the 6502 micro manufactured by MOS Technology and second-sourced by Rockwell and others. The VIA is a complicated device and no attempt will be made here to explain its private parts in gory detail. In any case, only half of it is available to the user (the 'A' side), the other half (the 'B' side) is dedicated to the sophisticated IEEE PORT (apart from one line, CB2).

The first thing to realise is that the VIA is a 'memory mapped' device which means that, as far as the programmer is concerned, the various registers inside behave as *memory locations*, each with its own special address. There are sixteen addresses allotted to the VIA which should give some idea of its internal complexity. It is not simply an input/output device; it has programmable shift

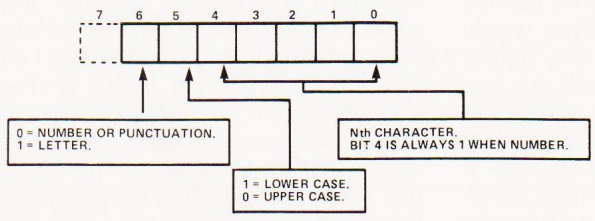


Fig. 1. The seven-bit structure of ASCII code revealed. The least significant bit is bit 0, bit 7 is the optional parity bit which is sometimes used for graphics etc.

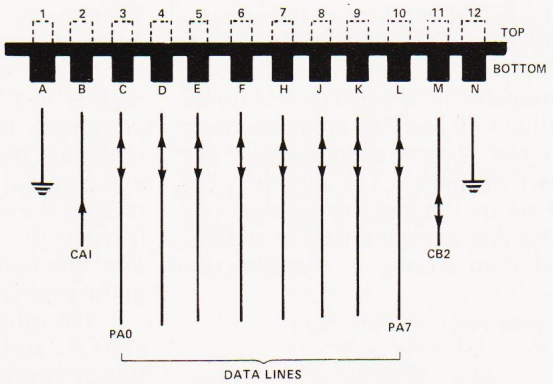


Fig. 2. The pin connections to the 24 way User Port connector.

registers and counters each with its own private address. To attempt a detailed study of this lot before you begin using it is a recipe for disaster and almost certainly will put you off the thing for life! It is best to nibble at it, a bit at a time (Yrch! Ed) and then have a rest for a week to recover. There are, of course, a few brilliant individuals about who manage to lap up the lot in one casual glance at the manufacturer's data sheets but the writer and other normal members of society are not so favoured.

Let's start with the two straightforward registers and their addresses in the PET memory map. They are both on the User Port side (the 'A' side).

THE DATA DIRECTION REGISTER
at address E843 Hex or 59459 decimal
THE OUTPUT REGISTER
at address E84F Hex or 59471 decimal

These two registers control the behaviour of the eight input/output DATA lines PA0,PA1...PA7 which can be used to control or sense external equipment. Are they inputs or outputs? The answer is that you can decide this by programming the contents of the direction register at E843. Any '1' in this register will cause the corresponding line in the output register to be an OUTPUT and a '0' an INPUT. This is normally done once at the beginning of the program unless, of course, any one of the external devices suddenly decides to change its sex during a program run. Once the direction has been established, the OUTPUT REGISTER at address E84F may be considered as lines PA0 to PA7. Note very carefully the amazing flexibility of this arrangement. We can decide for example that PA0 and PA3 are to be *inputs* and the rest *outputs* or indeed any permutation we desire. The direction bits can be set by loading the required pattern in the Acc using immediate addressing and then storing in the direction register.

Example: make PA0 to PA7 all outputs.

```
LDAIM FF
STA   E843
```

Example: make PA0,PA1,PA2,PA3 inputs and the rest outputs.

```
LDAIM 0F
STA   E843
```

It is important to realise that the direction register contents have no effect on the actual data lines other than their direction. Thus if we make them all outputs by storing FF (all '1') in the direction register this *does not mean* that the outputs will be at the '1' state. The only way to establish the actual logic on the data lines is by the contents of the OUTPUT register where outputs are concerned and the state of the external equipment where inputs are concerned. To illustrate this a few more examples are helpful.

Example: make all the outputs and turn them all to the '1' state.

```
LDAIM FF
STA   E843
STA   E84F
```

Example: make PA6 and PA7 inputs and the rest outputs, then set these outputs to '0' except PA3.

Since this is a bit involved, it is best to scribble out the bit patterns as follows before attempting the code;

Direction register must have the pattern 0 0 1 1 1 1 1 1 (3F Hex)

Output register must have the pattern 0 0 0 0 1 0 0 0 (08 Hex)

The coding is therefore,

```
LDAIM 3F
STA   E843
LDAIM 08
STA   E84F
```

There is one little mystery to be tackled in the previous example. What would happen if we put '1s' in the output register in the positions which are programmed as inputs? The answer is nothing! The input lines ignore the data in the output register. Thus if we write '1' or '0' in the register it would have no effect on the lines programmed by the direction register as inputs (PA6 and PA7 in the example).

The other two special lines are CA1 and CA2 and are given the rather strange title of 'handshake lines' which describes only one of their capabilities. Apart from stating that CA1 can *only* be an input and CA2 can be programmed as an input or an output, the details will be better postponed until some practice is obtained on the relatively simple data lines.

Building A Display Panel

The User Port is designed for controlling or being controlled by external devices. These can be simple switches, lamps, relays or more sophisticated devices like analogue/digital converters, keyboards, printers, TV displays etc. Before attempting any grandiose schemes, it is advisable to build a simple type of lamp, switch and socket panel which plugs into the user port edge connector. Armed with this contraption we can try out some simple control programs and witness the result.

The circuit diagram, Fig. 3, is simple (in fact stark) and should cause few problems during the construction stage. The components can be obtained from any retail shop or direct from one of the mail order firms. The list is, LEDs (10 off), miniature single-pole toggle switches (10 off), TTL inverters 7404 (2 off), miniature banana type sockets (12 off). You will also need the 24 way socket which mates with the user port... which are not too easily obtainable. There are three ways to obtain the 5 V power supply. You can build a regulated mains power supply (the proper way). You can pinch the 5 V line from the second cassette buffer socket, pin A is ground, pin B is + 5 V (not recommended). You can do what I did... use a 4V5 dry battery which is cheap, convenient and safe. We lose half a volt but who worries? The resistor values shown are not too critical. The 150 R in the LEDs can be reduced for brighter lights but the current consumption will increase.

The panel Fig. 4 consists of ten LEDs to indicate the logic state of the lines, 12 sockets to terminate the line (small banana type) and ten simple toggle swit-

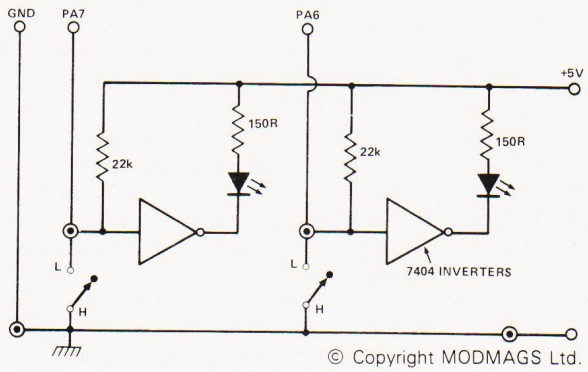


Fig. 3. Two of the 10 identical display circuits for the panel.

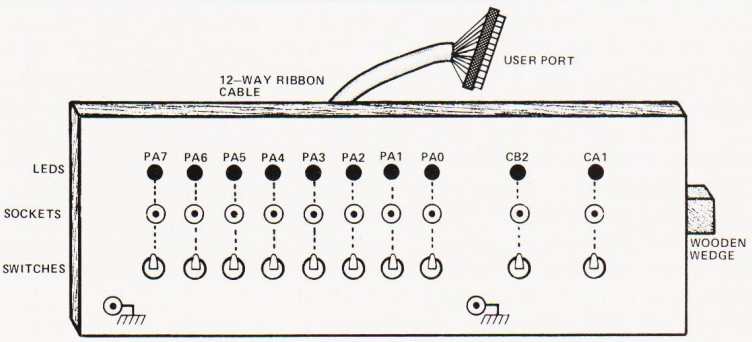


Fig. 4. A suggested layout for the display panel. The small wedge can be used to jam the box in the slot on the side of the PET.

ches. The wiring is only shown for two of the lines as the remaining eight are identical. The available current when the lines are outputs is insufficient to drive LEDs so a couple of TTL inverter ICs are used to provide inversion and current buffering. Wires programmed as outputs will only operate if the switches are left in the OPEN position to avoid the irresistible-force/immovable object clash. A small 'Verobox' is ideal for the panel and, if a short wooden wedge is screwed to the edge as shown in the diagram, it can be squeezed into that convenient little slot between the PET display and the body. No unsightly wires are then exposed. Just one word of warning regarding the use of the line sockets. When using them as outputs to 'drive' other gadgets *always* make the *input* of a standard TTL gate the immediate load. Conversely, when using them as inputs, always drive them from the output of a TTL gate. In other words, don't use the sockets 'raw'. . . in case of accidents!

Delays

The computer works very fast and experimental programs which switch the lamps on and off in various sequences must be slowed down by a delay loop in order to avoid meaningless blurs. If we put say, FF, in one of the registers or a memory location and decrement the contents until zero is reached the loop will revolve 255 times which, of course, takes time. Unfortunately, for humans, it doesn't take long enough! Since precision delays are often required, it is well to know the procedure for calculating loop execution times. First we must consult the 6502 Software Manual to determine the number of CLOCK CYCLES required for the instructions used. Because the PET uses a nice round clock frequency of 1 MHz it follows that one clock pulse takes 1 uS. Study the following three examples of programming a delay loop:

```
LDXIM FF      LDAIM FF      LDAIM FF
B DEX         B SBCIM 01    STA 06 00
  BNE B         BNE B       B DEC 06 00
                              BNE B
```

In all the above, the loop is back to line 'B' from BNE so we shall ignore the instruction/s which precede it. The manual states that DEX, SBCIM and BNE take two cycles each but DEC (absolute addressing) takes six cycles. The first two examples thus take 255 revs of four cycles, giving a time delay of 1020 uS or 1.02 mS. The third example is 255 revs of eight cycles, giving a time delay of 2.04 mS. These results indicate that simple loops of this form are unable to produce sufficient delays for humans staring at blinking lights. The only way out is to have a loop within a loop which has the effect of multiplying the delay time of the inner loop by the delay of the outer. We could, for instance, put FF in the Acc and the same in the X register to start the loops off. Since the arrangement will often be required we shall program it formally as a subroutine, this is shown in **PROGRAM 13.**

Assuming the timing parameters (posh name for the starting numbers in Acc and X) are as shown, the delay will be 255 times the inner loop delay which comes to about ¼ S. Still not a lot, but tolerable. However, suppose we want still more delay, say half a minute or more. This can be achieved by programming another loop and using the above subroutine in the middle of it. This could itself be a composite subroutine, see **PROGRAM 14.**

This is an example of nested subroutines because a subroutine calls up another one before it returns to the original caller. The return addresses are automatically stored in the STACK *before* the machine obeys a subroutine call and because of the LIFO action, 'inside' returns find their way back in the correct order. It is perhaps unnecessary to stress that when using subroutine **PROGRAM 14** situated at starting address 0390 it won't work unless **PROGRAM 13** is 'in situ' at address 0380. The actual addresses are of course arbitrarily chosen in the examples and can be anywhere providing they and the program which calls them don't overlap each other. Program modules are like wild creatures in nature who cherish and guard their own territory. The timing parameters shown (FF) represent the maximum delay possible but it is obvious that changes can be used to 'fine tune' to any precise delay. Another variation which gives increased flexibility is to remove the parameters from the subroutine and define them in the calling program before using JSR. Having sorted out the delay problems the next task is to try out a few flashing light exercises on the display panel. **PROGRAM 15** gives an example.

Get this to work and try a few variants as follows;
Change ROL (code 2E) to ROR (code 6E) to make lights reverse in direction.
Change again to INC (code EE) to make lights count up in binary
Change again to DEC (code CE) to make lights count down in binary

Further Experimentation

For those who wish to use the VIA for more practical purposes there is, elsewhere in this issue, an article on an analogue to digital converter which can be attached to the 6522 VIA. The control program for this has been published in BASIC but the machine code section you have just read should allow you to program it in 6502 code.

PROGRAM 13. Subroutine DELAY (¼ second maximum)

0380	A9 FF	LDAIM FF	Set timing parameter of outer loop in Acc
	A2 FF	S LDXIM FF	Set timing parameter of inner loop in X
	CA	B DEX	Take 1 off X
	D0 FD	BNE B	Branch back to B if not zero
	E9 01	SBCIM 01	Take 1 off Acc
	D0 F7	BNE S	Branch back to S if not zero
	60	RTS	Return

PROGRAM 14. Subroutine DELAY

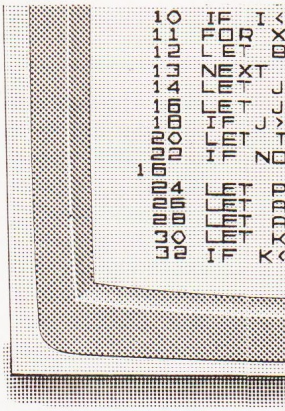
0390	A0 FF	LDYIM FF	Set timing parameter in Y
	20 80 03	K JSR 03 80	Call up ¼ second delay subroutine
	88	DEY	Take 1 off Y
	D0 FA	BNE K	Take back to K if not zero
	60	RTS	Return

PROGRAM 15. Make a single light appear to 'revolve' around the panel ten times.

0340	A9 FF	LDAIM FF	Set direction register of port
	8D 43 E8	STA E8 43	
	A9 00	LDAIM 00	Clear user port (start all lamps off)
	8D 4F E8	STA E8 4F	
	38	SEC	Set carry
	A9 0A	LDAIM OA	Set loop to count to ten, using address 03600
	8D 60 03	STA 03 60	
	20 80 03	K JSR 03 80	Subroutine ¼ second delay
	2E 4F E8	ROL E8 4F	Rotate user port left
	CE 60 03	DEC 03 60	Take 1 off loop count
	D0 F5	BNE K	Branch back to K if not zero
	00	BRK	Stop
0360			Reserved for counter
0380			Subroutine ¼ second delay starting address which must be entered from here onwards.

New! Sinclair ZX81 Personal Computer.

Kit: £49.95 complete



Reach advanced computer comprehension in a few absorbing hours

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. At £99.95, the ZX80 offered a specification unchallenged at the price.

Over 50,000 were sold, and the ZX80 won virtually universal praise from computer professionals.

Now the Sinclair lead is increased: for just £69.95, the new Sinclair ZX81 offers even more advanced computer facilities at an even lower price. And the ZX81 kit means an even bigger saving. At £49.95 it costs almost 40% less than the ZX80 kit!

Built: £69.95 complete

Lower price: higher capability

With the ZX81, it's just as 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, or to select a program off a cassette through the keyboard.

Higher specification, lower price – how's it done?

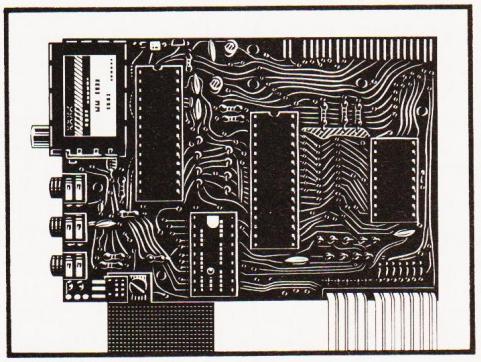
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

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!

Kit or built – it's up to you!

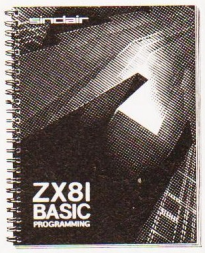
The picture shows dramatically how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

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

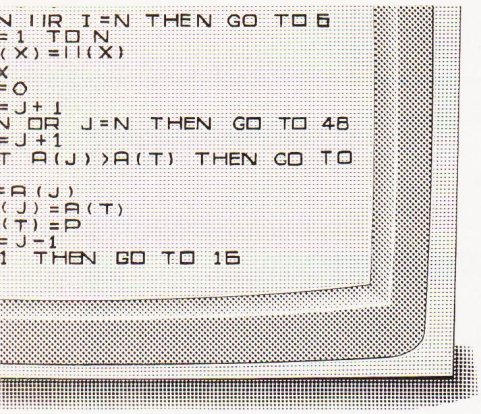


Proven micro-processor, new 8K BASIC ROM, RAM – and unique new master chip.

New Sinclair teach-yourself BASIC manual



Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs. You need no prior knowledge – children from 12 upwards soon become familiar with computer operation.



lew, improved specification

- Z80A micro-processor – new faster ersion 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 umerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function – useful for games s well as serious applications.
- Cassette LOAD and SAVE with amed programs.
- 1K-byte RAM expandable to 16K ytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer ıot available yet – but coming soon!)
- Advanced 4-chip design: micro-rocessor, ROM, RAM, plus master chip unique, custom-built chip replacing 3 ZX80 chips.

sinclair
ZX81

Sinclair Research Ltd,
5 Kings Parade, Cambridge, Cambs.,
CB2 1SN. Tel: 0276 66104.
Reg. no: 214 4630 00

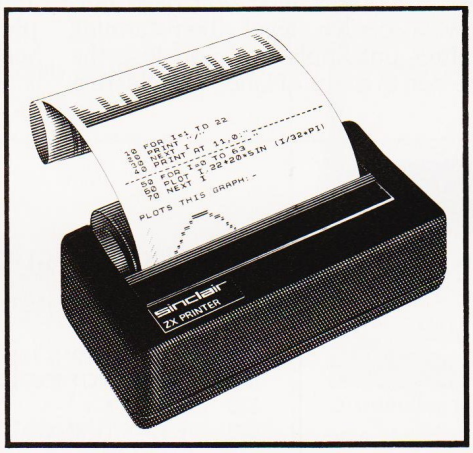
If you own a Sinclair ZX80...

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.

Coming soon- the ZX Printer.

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alphanumerics across 32 columns, *and* highly sophisticated graphics. Special features include COPY, which prints out exactly what is on the whole TV screen without the need for further instructions. The ZX Printer will be available in Summer 1981, at around £50 – watch this space!



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

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

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

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BY PHONE – Access or Barclaycard 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 or Barclaycard.

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	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	
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	8K BASIC ROM to fit ZX80.	17	19.95	
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KINGDOMS

C J Davies

A BASIC adaptation of one of CT's classic games

Kingdoms is a land and resource management game and this version is based fairly closely on the flowcharts by A R Larkham, published in the July 1980 edition of Computing Today.

At the start of the game you have 5,000 sacks of corn, 1,000 subjects and 200 acres of land. It takes four sacks of corn to feed one person for one year and eight sacks to plant one acre. Each person can plant two sacks and can harvest 16.

Playing The Game

During the game the harvest can be either good, bad or average. A good harvest gives a yield of eight for one, a bad harvest two for one. In any year an average harvest is most likely and a good harvest least likely.

If you plant more than 75% of your land in one year then your land will be increased by 25% the next year as a result. If not, then you lose 25%.

To increase the population simply give out more food, as this attracts people. If you give out twice as much food as needed then you will double the population.

Winning

There are two ways to win the game. The first is to survive for 20 years. This is not too difficult as long as you are careful. The second way to win is to accumulate more than 32,000 sacks of corn. This is much more difficult and I have only managed it once or twice myself.

Losing

As is to be expected, there are more ways of losing than there are of winning. If the amount of land you have falls below a certain level then farming becomes untenable and you lose the game due to a lack of land. A similar rule applies to your subjects. The last, and most decisive, way to lose is by being assassinated! If you starve more than 25% of the population in any one year then they will attempt to assassinate you with a one in three chance of succeeding.

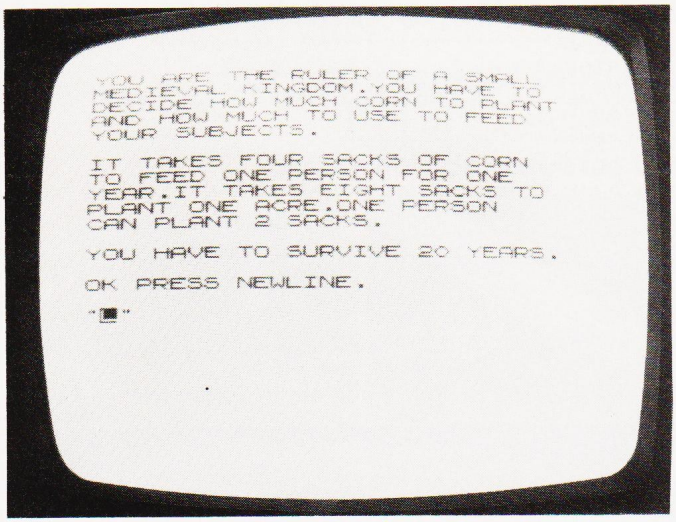
If you would prefer a longer game, try changing it to 50-year game by altering lines 445 and 9105.

The Program

The program has been written to run on the Sinclair ZX80 with 4K Integer BASIC and 4K of RAM. There are no tricks in the program so it should be easy to transfer it to any machine running Integer BASIC. If you are transferring it and your machine doesn't have logical operators (AND, OR, NOT) then lines like 180 will have to be broken up into a couple of lines. The 'CLS' statement is clear screen and the function RND(N) generates a random integer in the range 1 to N.

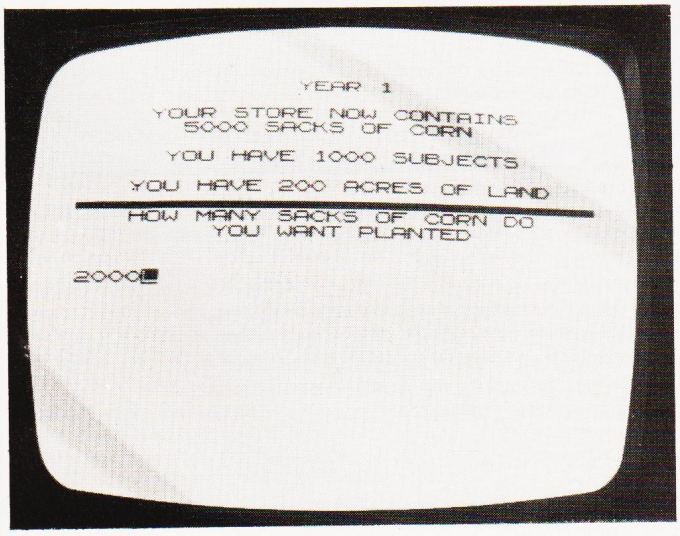
Program Listing

```
100  PRINT ,"[4 SPC] KINGDOMS "
110  PRINT
120  PRINT "[32 ^W]"
130  PRINT "[4 SPC] DO YOU WANT INSTRUCTIONS"
140  PRINT
150  PRINT "1.YES"
160  PRINT "2.NO"
170  INPUT X
180  IF NOT X<1 AND NOT X>2 THEN GOTO 210
190  PRINT "MUST BE 1 OR 2"
200  GOTO 170
210  CLS
220  IF X=1 THEN GOSUB 9000
230  LET Y=0
240  LET C=5000
250  LET S=1000
260  LET L=200
300  LET Y=Y+1
340  CLS
345  LET K=0
350  PRINT ,"[5 SPC] YEAR ";Y
360  PRINT
370  PRINT "[4 SPC] YOUR STORE NOW CONTAINS"
380  PRINT "[6 SPC]";C;" SACKS OF CORN"
390  PRINT
400  PRINT "[5 SPC] YOU HAVE ";S;" SUBJECTS"
410  PRINT
420  PRINT "[3 SPC] YOU HAVE ";L;" ACRES OF LAND"
430  PRINT "[32 ^W]"
445  IF Y=21 THEN GOTO 1810
450  PRINT "[3 SPC] HOW MANY SACKS OF CORN DO"
460  PRINT ," YOU WANT PLANTED"
470  PRINT
480  INPUT P
490  IF NOT P>C THEN GOTO 520
500  PRINT "[4 SPC] YOU HAVENT GOT THAT MUCH"
505  LET K=K+1
508  IF K=4 THEN GOTO 340
510  GOTO 480
520  IF NOT P>2*S THEN GOTO 550
530  PRINT "NOT ENOUGH PEOPLE TO PLANT IT"
535  LET K=K+1
538  IF K=4 THEN GOTO 340
540  GOTO 480
550  IF NOT P>8*L THEN GOTO 580
560  PRINT ,"NOT ENOUGH LAND"
565  LET K=K+1
568  IF K=4 THEN GOTO 340
570  GOTO 480
580  PRINT
585  LET C=C-P
600  PRINT "[3 SPC] HOW MANY SACKS OF CORN DO"
610  PRINT "[3 SPC] YOU WANT GIVEN OUT AS FOOD"
615  PRINT, "[3 SPC] YOU HAVE";C
620  PRINT
630  INPUT F
640  IF NOT F>C THEN GOTO 670
650  PRINT"[4 SPC] YOU HAVENT GOT THAT MUCH"
655  LET K=K+1
657  IF K=5 THEN LET C=C+P
658  IF K=5 THEN GOTO 340
660  GOTO 630
670  LET C=C-F
680  CLS
700  LET Z=1
710  LET A=P/8
720  LET X=L*3/4
730  IF A<X THEN LET Z=-1
740  LET G=Z*L/4
750  LET L=L+G
```



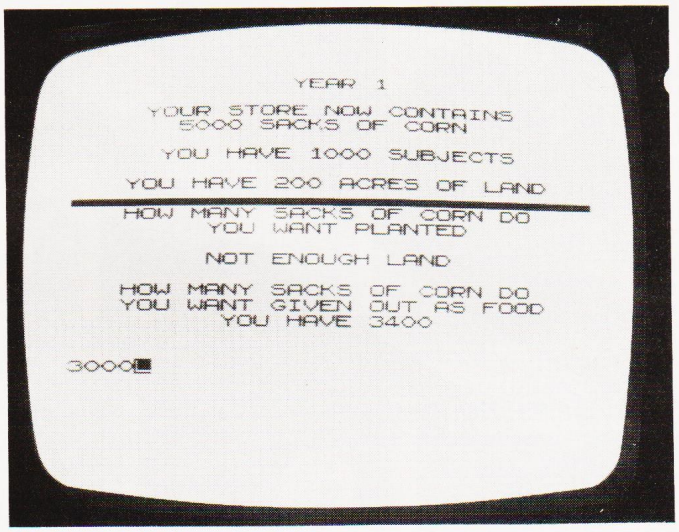
The game instructions as displayed on the screen.

```
760   LET ZP = 1
770   LET M = 1
780   LET E = F/4
790   IF E < S THEN LET ZP = -1
800   LET GP = (E - S)*ZP
810   LET X = S*3/4
820   IF E < X THEN LET M = -1
830   LET S = E
840   RAMDOMISE
850   LET X = RND(3)
900   IF Z < 0 THEN GOTO 940
910   PRINT "[2 SPC]YOU HAVE INCREASED YOUR LAND"
920   PRINT ,"BY ";G;" ACRES"
930   GOTO 950
940   PRINT "[4 SPC] YOU HAVE LOST";G*Z;" ACRES"
950   PRINT
951   IF L > 12 THEN GOTO 960
952   PRINT "[31^W][^D]"
953   PRINT "[^Q]",,,"[6 SPC][^Q]
954   PRINT "[^Q][3 SPC] YOU HAVE LOST THE GAME
      [5 SPC][^Q]"
955   PRINT "[^Q][3 SPC] DUE TO A LACK OF LAND [5 SPC]
      [^Q]"
956   PRINT "[^Q]",,,"[6 SPC][^Q]"
957   PRINT CHR$(133);"[30^W][^Q]"
958   STOP
960   IF GP = 0 THEN GOTO 1290
970   IF ZP < 0 THEN GOTO 1000
```



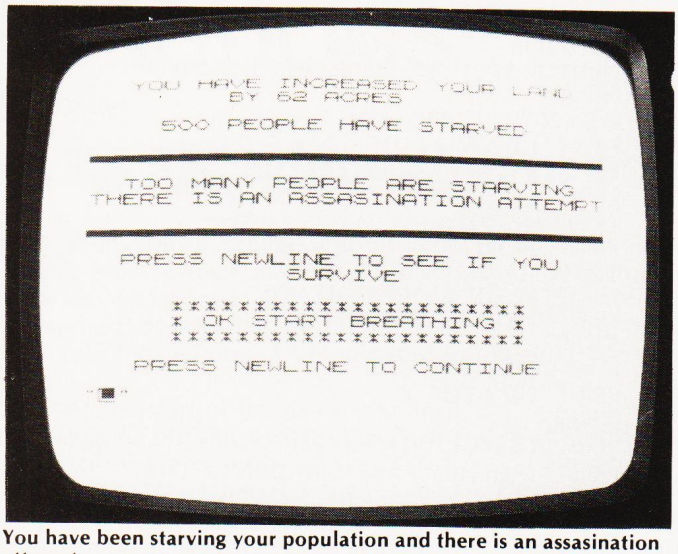
Your initial allotment of subjects and food supplies.

```
980   PRINT " YOU HAVE GAINED";GP;" SUBJECTS"
990   GOTO 1010
1000  PRINT"[4 SPC]";GP;" PEOPLE HAVE STARVED"
1010  PRINT
1020  IF S > 24 THEN GOTO 1100
1030  PRINT "[31^W][^D]"
1040  PRINT "[^Q]",,,"[6 SPC][^Q]"
1050  PRINT "[^Q][4 SPC] YOU HAVE LOST THE GAME
      [4 SPC][^Q]"
1060  PRINT "[^Q][2 SPC] DUE TO A LACK OF SUBJECTS
      [3 SPC][^Q]"
1070  PRINT "[^Q]",,,"[6 SPC][^Q]"
1080  PRINT CHR$(133);"[30^W][^Q]"
1090  STOP
1100  IF M > 0 THEN GOTO 1290
1110  PRINT "[32^W]"
1115  PRINT
1120  PRINT "[2 SPC] TOO MANY PEOPLE ARE STARVING"
1130  PRINT "THERE IS AN ASSASINATION ATTEMPT"
1135  PRINT
1140  PRINT "[32^W]"
1150  PRINT
1160  PRINT "[2 SPC] PRESS NEWLINE TO SEE IF YOU"
1170  PRINT ,"[4 SPC] SURVIVE"
```



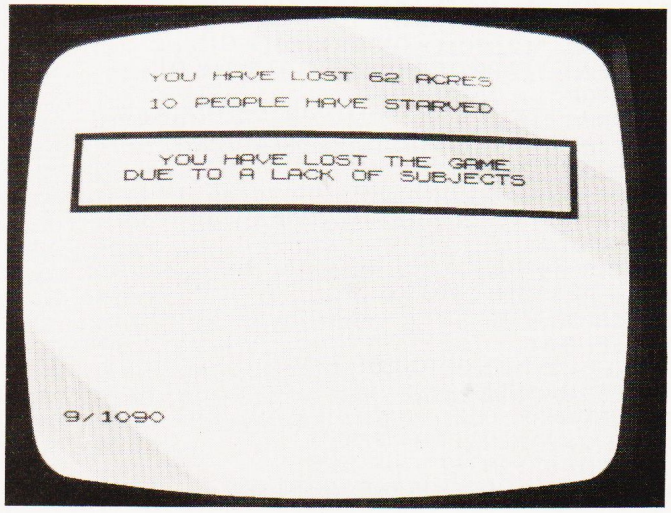
Distributing the harvest in year 1.

```
1175  PRINT
1178  INPUT A$
1180  FOR D = 1 TO 300
1190  NEXT D
1200  IF X > 1 THEN GOTO 1270
1210  PRINT ,"[2 SPC][10^W][^D]"
1220  PRINT ,"[2 SPC][^Q]" [9 SPC][^Q]"
1230  PRINT ,"[2 SPC][^Q]" YOU DIED [SPC][^Q]"
1240  PRINT ,"[2 SPC][^Q]" [9 SPC][^Q]"
1250  PRINT ,"[2 SPC]";CHR$(133);"[9^W][^Q]"
1260  STOP
1270  PRINT "[5 SPC] **********************"
1280  PRINT "[5 SPC] * OK START BREATHING *"
1285  PRINT "[5 SPC] **********************"
1290  PRINT
1300  PRINT "[3 SPC] PRESS NEWLINE TO CONTINUE"
1310  INPUT A$
1320  CLS
1400  IF P < 1 THEN GOTO 300
1410  LET W = 1
1420  LET B = 1
1425  IF P < 20 THEN GOTO 1580
1430  LET Q = RND(6)
1440  LET H = (P/10)*2
1450  IF Q > 2 THEN LET H = (P/10)*4
1460  IF Q = 6 THEN LET H = (P/10)*8
1470  IF NOT H > (S/10)*16 THEN GOTO 1530
```

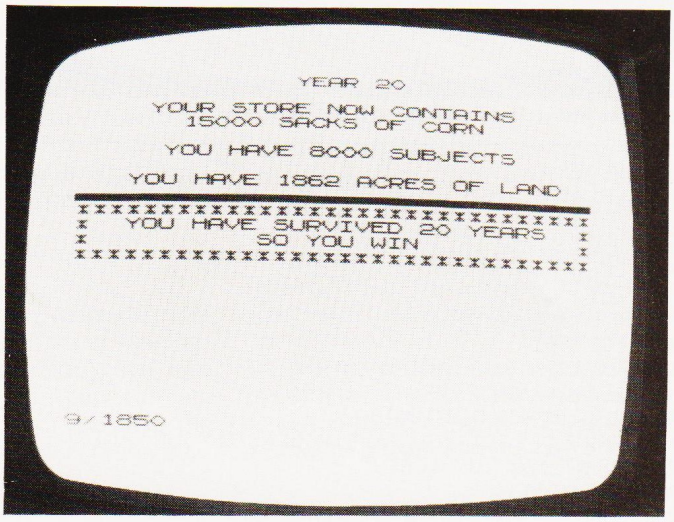


You have been starving your population and there is an assasination attempt.

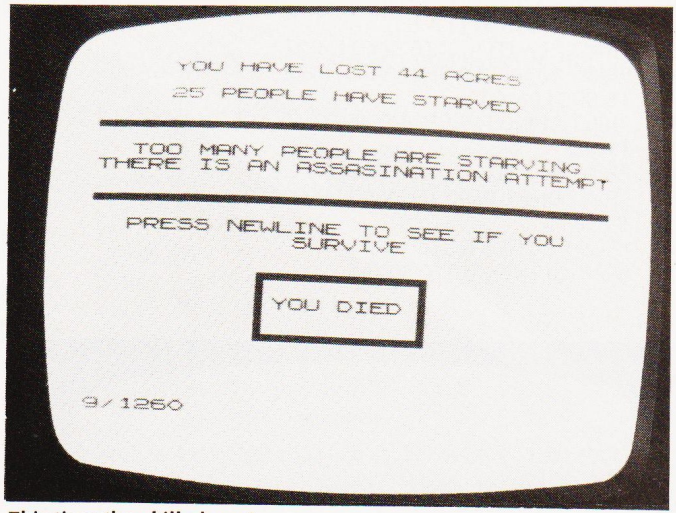
```
1480  LET B = -1
1490  LET N = H - (S/10)*16
1500  IF N = N*10
1500  IF N>3200 THEN LET N = 3200
1510  LET N = N*10
1520  LET H = (S/10)*16
1530  IF C/10+H>3200 THEN GOTO 1560
1540  LET C = C+H*10
1550  GOTO 1600
1560  LET W = -1
1570  GOTO 1600
1580  LET Q = 3
1590  LET C = P*2+C
1600  FOR D = 1 TO 150
1610  NEXT D
1620  PRINT
1630  IF Q<3 THEN PRINT "[3 SPC] THE HARVEST HAS BEEN
      POOR"
1640  IF Q>3 AND Q<6 THEN PRINT "[3 SPC] THE HARVEST
      HAS BEEN AVERAGE"
1650  IF Q=6 THEN PRINT "[3 SPC] THE HARVEST HAS BEEN
      GOOD"
1660  PRINT
1670  PRINT "[32 ^ W]"
1675  PRINT
1680  IF B>0 THEN GOTO 1710
1690  PRINT "[2 SPC]";N;" SACKS LOST DUE TO LACK"
1700  PRINT ,"[2 SPC] OF MANPOWER"
1705  PRINT
1710  IF W>0 THEN GOTO 1770
1720  PRINT "**********************************"
1730  PRINT "*[2 SPC] YOU HAVE OVER 32000 SACKS
      [3 SPC]*"
```




```
1740  PRINT "*[6 SPC] OF CORN SO YOU WIN [6 SPC]*"
1750  PRINT "**********************************"
1760  STOP
1770  PRINT "[3 SPC] PRESS NEWLINE TO CONTINUE"
1780  INPUT A$
1790  CLS
1800  GOTO 300
1810  PRINT "**********************************"
1820  PRINT "*[2 SPC] YOU HAVE SURVIVED 20 YEARS
      [2 SPC] *"
1830  PRINT "*[10 SPC] SO YOU WIN [10 SPC] *"
1840  PRINT "**********************************"
1850  STOP
9000  PRINT " YOU ARE THE RULER OF A SMALL"
9010  PRINT "MEDIEVAL KINGDOM. YOU HAVE TO"
9020  PRINT "DECIDE HOW MUCH CORN TO PLANT"
```



You just survived your 20 year reign.



This time they killed you!

```
9030  PRINT "AND HOW MUCH TO USE TO FEED"
9040  PRINT "YOUR SUBJECTS."
9045  PRINT
9050  PRINT "IT TAKES FOUR SACKS OF CORN"
9060  PRINT "TO FEED ONE PERSON FOR ONE"
9070  PRINT "YEAR. IT TAKES EIGHT SACKS TO"
9080  PRINT "PLANT ONE ACRE. ONE PERSON"
9090  PRINT "CAN PLANT 2 SACKS."
9100  PRINT
9105  PRINT "YOU HAVE TO SURVIVE 20 YEARS."
9106  PRINT
9110  PRINT "OK PRESS NEWLINE."
9120  INPUT A$
9130  CLS
9140  RETURN
```

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AGENTS THROUGHOUT THE UK AND OVERSEAS

MOTOR RACING

M D Joyce

Keep your hands on the wheel, your eyes on the road!

The following short program was written primarily for use on the basic UK101, but is straightforward and easily adaptable to any system. The object of the game is to keep your car on the road without crashing it into anything, while on the VDU the road moves up the screen to the car along with other cars you will be overtaking. Keys 1 and 2 move the car to the left and to the right, and key 3 will give you a braking facility.

Variables And Characters

D = car position
X = number of laps/10
G and T = opposing cars
H = lap counter
E = road position
M = car speed
R = random number 1,0, or −1
S = random number between 0 and 19
1 = car
39 = '

Notes

POKE 530,1 POKE 57088 and PEEK(57088) are used to get key characters without stopping the program. Lines 120, 130 and 135 test keys 1, 2 and 3, and line 140 constructs the road and potential obstructions; the 3 spaces in line 140 may be increased or decreased to vary the difficulty. The variable in line 15 may be altered to give more laps (500 will give 50 laps).

Program Listing

```
5    FOR A=1 TO 10:PRINT:NEXT A
10   D=53408:X=400
15   G=32:T=32:H=0:E=15:M=150
20   PRINT "MOTOR RACING, Try to complete the course without
     crashing"
30   PRINT "1=Go left 2=Go right 3=Brake"
40   PRINT:PRINT" Type RETURN to go."
70   POKE 530,1:POKE 57088,223
80   IF PEEK(57088)=247 GOTO 100
90   GOTO 70
100  POKE 57088,127:C=PEEK(57088)
120  IF C=127 THEN D=D-1
130  IF C=191 THEN D=D+1
135  IF C=223 THEN M=100
140  PRINT TAB(E)" ' ";CHR$(G);"[3 SPC]";CHR$(T);" ' "
150  POKE D,1
160  R=INT(3*RND(5)-1):E=E+R
180  IF E<1 THEN E=1
190  IF E>30 THEN E=30
200  S=INT(20*RND(7)):G=32:T=32
220  IF S=1 THEN G=1
230  IF S=2 THEN T=1
300  IF PEEK(D+64)=39 GOTO 1000
310  IF PEEK(D+64)=1 GOTO 700
330  H=H+1
410  IF H=X GOTO 900
450  FOR Q=1 TO M:NEXT Q
460  M=M-5
470  IF M<1 THEN M=1
500  ROKE D,32:GOTO 100
700  PRINT "CRASHED"
710  IF H<60 THEN PRINT "BEGINNER"
720  PRINT
730  PRINT "You completed";INT(H/10);"out of";X/10;"laps"
750  END
900  PRINT "You completed the course like a professional"
960  GOTO 720
1000 PRINT "IN THE DITCH"
1010 GOTO 710
```

AMAZEING

Mark Michalowski and G Lowry

Find your way out of this one!

This game of skill runs easily on an 8K PET. Be warned — it is addictive! The player chooses the difficulty level, and a random maze appears. The player moves his asterisk via the keyboard — 2 down, 4 left, 6 right, 8 up — from bottom right to top left, in a maximum time of 80 seconds. As he plays, random blockages and openings will appear to help or confuse him. Level one is reasonably easy, but level three is almost impossible. Our best score for level one is 69 moves. Can you beat it?

Program Listing

```
50   PRINT"WHICH LEVEL - 1 TO 6 (6 HARDEST":INPUT U
60   IF U<1 OR U>6 THEN 50
70   IF INT(U)<>U THEN 50
80   FOR I=1 TO (U*100):A=INT(32768+33768*RND(1)):POKE
     A,102:NEXT I
90   A=32768:B=33768
100  POKE A,88:POKE B,42:F=0
110  TI$="000000"
120  GOSUB 1000
130  GOSUB 2000
140  GOTO 120
1000 PRINT TAB(37);VAL(TI$):IF VAL(TI$)=>120 THEN 1120
1010 GET A$:IF A$="" THEN 1060
1020 IF A$="2" THEN A=40:GOTO 1070
1030 IF A$="4" THEN A=-1:GOTO 1070
1040 IF A$="6" THEN A=1:GOTO 1070
1050 IF A$="8" THEN A=-40:GOTO 1070
1060 GOTO 1999
1070 D=PEEK(B+A):IF D=88 THEN 1110
1080 IF D<>32 THEN 1999
1090 IF (B+A)>33768 OR (B+A)<32768 THEN 1999
1100 F=F+1:POKE B,32:B=B+A:POKE B,42:GOTO 1999
1110 PRINT CHR$(147):PRINT "WELL DONE! YOU'VE BEATEN MY
     MAZE IN ONE MINUTE TWENTY, AND "F" MOVES!":END
1120 PRINT CHR$(147):PRINT"SORRY. YOUR TIME'S UP.":END
1999 RETURN
2000 FOR I=1 TO INT(1+10*RND(2))
2010 G=INT(32768+33768*RND(3))
2030 IF G<>32 OR G<>102 THEN NEXT I
2035 POKE G,32:NEXT I
2040 FOR I=1 TO INT(1+10*RND(4))
2050 G=INT(32768+33768*RND(5))
2060 IF G<>32 OR G<>102 THEN NEXT I
2070 POKE G,102:NEXT
2999 RETURN
```

NASBUS NEWS

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The proven Nascom-2 microcomputer can now be bought as a complete system from £1549+ VAT. For this price you get the Nascom-2 kit, 16K RAM board kit, Kenilworth case with 2 card frame, Centronics 737 printer, 10 inch monitor, and the Gemini Dual Drive Floppy Disk System. The CPU and RAM boards are also available built – the additional cost is available on application.

GEMINI G805 FLOPPY DISK SYSTEM FOR NASCOM-1 & 2

It's here at last. A floppy disk system and CP/M.

CP/M SYSTEM. The disk unit comes fully assembled complete with one or two 5¼" drives (FD250 double sided, single density) giving 160K per drive, controller card, power supply, interconnects from Nascom-1 or 2 to the FDC card and a second interconnect from the FDC card to two drives, CP/M 1.4 on diskette plus manual, a BIOS EPROM and new N2MD PROM. All in a stylish enclosure.

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D-DOS SYSTEM. The disk unit is also available without CP/M to enable existing Nas-Sys software to be used. Simple read, write routines are supplied in EPROM. The unit plugs straight into the Nascom PIO.

Single drive system ..... **£395 + VAT**
(please state which Nascom the unit is for)
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Kenilworth case ..... **£49.50 + VAT**
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This Nasbus compatible EPROM board accepts up to 16, 2716 or 2708 EPROMs
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The Castle interface is a built and tested add-on unit which lifts the Nascom-2 into the class of the fully professional computer. It mutes spurious output from cassette recorder switching, adds motor control facilities, automatically switches output between cassette and printer, simplifies 2400 baud cassette operating and provides true RS232 handshake.

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For really interesting and useful interactions with the 'outside world' the Milham analogue to digital converter is a must. This 8-bit converter is multiplexed between four channels – all software selectable. Sampling rate is 4KHz. Sensitivity is adjustable. Typical applications include temperature measurement, voice analysis, joystick tracking and voltage measurement. It is supplied built and tested with extensive software and easy connection to the Nascom PIO. Milham A-D Converter (built and tested).... **£49.50 + VAT**

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12 x 8 piggy-back board for Nascom-1 offering five-slot motherboard, quality 5A power supply and reliable buffering with reset jump facility. **Price £85 + VAT.**

BITS & PC's PCG

5 x 4 board which plugs straight into Nascom-2. Operates on cell structure of 128 dots, producing 64 different cells. Once defined, each cell may be placed anywhere, any number of times on screen simultaneously. Max screen capacity: 768 cells. Dot resolution: 384 x 256 = 98304. Many other features including intermixing of alpha-numeric characters and pixels. **Price (kit) £60 + VAT.**

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Newly developed Nasbus compatible board that can accommodate up to 64K of RAM including Page Mode facility. **Prices: £110 (16K), £130 (32K), £150 (48K), £170 (64K). Add VAT to all prices.**

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The powerful text editor written for the Nascom is now available on a 5¼ inch floppy disk with a number of new features. **Price £43.25 + VAT.**

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Allows monitoring of input and output of Nascom PIO. This board can generate interrupts and simulate handshake control. **Price (kit) £17.50 + VAT.**

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PROGRAMMING STANDARDS

Henry Budgett

Make your program listings more acceptable with CT's standard code.

It has been very encouraging over the last six months or so to see the number of programs that have been submitted using our standard codes for graphics and other non-printable characters. However, it has also become increasingly clear that some of our readers haven't heard of them and this article is intended to set them out once again together with a few of the more recent additions to the set.

Please do not imagine that we only consider programs submitted for publication which conform to our standards. This is not so, although they do make life easier, both for the programmer and for us.

All standards tend to be irksome to adhere to but the ones laid out here are fairly simple and tend to make software easier to maintain by the programmer and simpler to understand for others.

Controlling That Cursor

It is fair to admit that the standards arose because, in the early days, we had a printer which could not reproduce the graphics characters produced by the PET (among others). One soon learned that a mysterious '3' appearing in the listings actually meant 'clear screen' but many of the other characters simply disappeared making documentation extremely difficult.

The original standards that emerged were simply aimed at getting round this problem and it is a tribute to their simplicity that they are becoming widely accepted. The standards for the cursor controls are given in Fig. 1.

The use of square brackets has raised one or two interesting queries. The actual reason for this choice is that *most* of the common microcomputer BASICs don't use them for specific functions. In fact, at least one machine provides an added bonus by returning a syntax error if they are found, a useful check in case you type them in by mistake.

The code [SPC] was added to the list of cursor control codes to get over the problem of indicating just how many spaces are contained in that gap in the printout. It is interesting to note that the ZX 80 Users' Group have recently published a set of programming standards specific to that machine and found the same problem. The code they chose to use was '*'.

The Graphic Solution

It soon became obvious that the techniques applied to the confusing cursor controls could also be applied to the graphic symbols. The following standard is now in general use in programs published in Computing Today.

If a graphics character or characters are to be displayed in a listing (as opposed to POKE codes or CHR$() codes) then they are indicated by the method shown in Fig. 2.

This can be taken further to include machines which use a pixel graphics set rather than pre-programmed PET-style characters and the series of codes for these is given in Fig. 2. (This previously appeared in CT January '81.) As is nearly always the case there is one machine to which the standard shown in Fig. 2 does not apply—the Tangerine Microtan/Micron. This machine uses a four by two cell structure for its pixel graphics instead of the Prestel/Teletext three by two cell. The method for calculating the value to assign to 'P' is shown in Fig. 3, and is fortunately nice and simple.

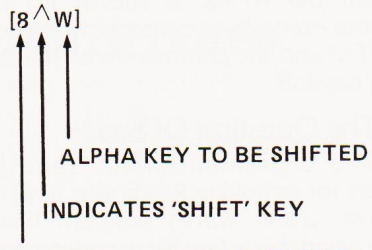

Fig. 2. The way we indicate block graphics such as those on the Sharp and PET.

Making REMarks

Many people scorn the use of REMs within programs but, during the development at least, they are extremely useful. One of the methods of documentation that I use is to keep my back-up copy of the programs I write on a 300 Baud CUTS tape with all the REMs in place: the working copy, be it on tape or disc, is REMless in order to save space.

Unfortunately, several utility packages are available offering a 'squash' routine which strips all the REMs out—great for a running copy of the program, but definitely *not* to be done to the program you submit for publication!

It is also good programming 'manners' to give your REMs odd line

[CLS]	CLear Screen
[HOM]	HOMe the cursor
[CL]	Cursor Left
[CR]	Cursor Right
[CU]	Cursor Up
[CD]	Cursor Down
[REV]	REVerse video on
[OFF]	Turn it OFF
[SPC]	SPaCe character

TO INDICATE MORE THAN ONE OF THE ABOVE AN OPTIONAL NUMBER CAN BE PLACED WITHIN THE BRACKETS; [4 CL] etc.

Fig. 1. The original cursor control codes that are still doing sterling service.

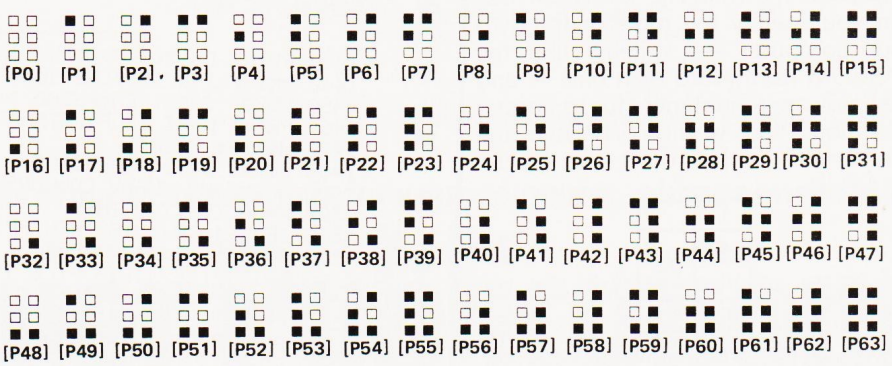

Fig. 3. The standard pixel codes, they will work on most computers that employ this technique as well as for Teletext and Prestel. The Tangerine family, however, use the format shown in Fig. 4.

numbers:

```
3999 REM**SPECIAL SUBROUTINE
4000 ....etc....
```

A remarkable number of submitted programs have jumps that go not to the relevant point in the program, but to the REM statement. If you run this through a 'squash' routine you can end up with a real mess. The format in which we publish the REMs is shown in the previous example; two asterisks between the REM and the comment with the latter in capitals.

The Question Of Space

The aforementioned 'squash' utilities for removing REMs also tend to remove spaces within program lines. Once again this is fine for a working program but tends to lead to classic lines such as:

```
FORK = 10TOMATOES
```

and other similar brain-scrambling nonsense! Once again *please* don't send in programs in this form. It makes it extremely hard to judge their quality as they are so difficult to unravel.

On the subject of space, it is always good practice to indicate the amount of memory that your program will occupy, together with the version of BASIC that it is running under.

Printout

We do like to see an actual printout of the program but, for technical reasons, we tend to reset any that are produced on a dot matrix printer. If you have access to a high quality printer such as a golfball or daisy, or to a printer like a Teletype which produces a complete character, we can reproduce these directly provided that each line contains less than 56 characters. If you have access to one of these devices, do remember to put a new ribbon in and use plain paper!

Coding The Machine

We regularly publish machine code programs and these too can be presented in a standard format. A typical example is shown in Fig. 4. It is *essential* that you specify the monitor fitted to your computer — systems like the NASCOM have more than one — and the hardware requirement for its correct operation. You wouldn't believe the number we see which don't even specify the CPU!

1	2
4	8
16	32
64	128

Fig. 4 To convert a Tangerine pixel code into its blocks simply decode the number into its binary or Hex value and fill in the relevant squares.

Documentitis

Ideally, program documentation (both for high level and machine code) should consist of a general description of the program's function, a detailed explanation of any parts that are specific to your computer or that do clever things, and suggestions as to how the program might be implemented on another machine.

An essential ingredient of any documentation is a list of any special characters used, for example POKE codes, and the variables used within the program and the functions they perform.

The inclusion of a flow chart certainly improves the package. A classic example of flowcharting can be found in our May '80 issue with the Stockmarket program. Originally written for a calculator, we have received many versions in both machine code and various high level languages coded up directly from these flowcharts.

Making your program more presentable will certainly increase its chances of acceptance, whether by a magazine like ourselves or by a commercial software house. No-one is going to spend valuable time disentangling a program supplied without at least some of the above requirements.

On a final note, if you have borrowed anyone else's ideas from *within* the pages of Computing Today then please credit the original source. Do *not* submit programs which have been 'borrowed' from other sources as in doing so you are breaking the laws of copyright and may have to suffer the consequences.

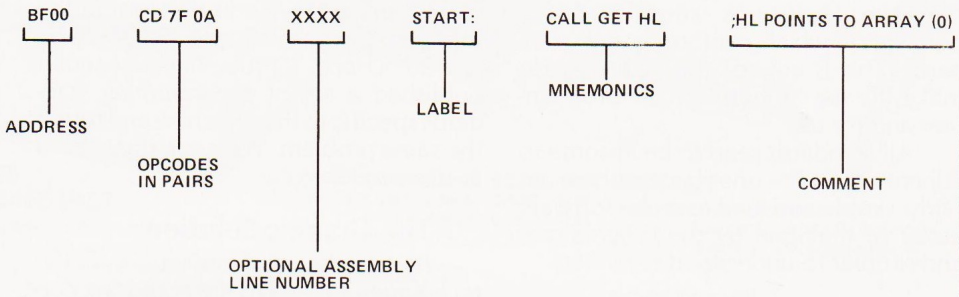

Fig. 5. Assembly language and machine code programs will generally fit into this format.

```
1500 PRINTCHR$(147):CLR:DIMA$(50,10)
1510 PRINTTAB(12)"■CREATE RECORD■":PRINT:
1520 GOSUB 2470:REM * LINE
1530 PRINT"WHAT IS FILE NAME ▒▒ ";:GOSUB2340:REM ** KEYBOARD INPUT **
1540 N$=I8$:PRINT
1550 GOSUB 2470:REM *LINE
1560 PRINT"HOW MANY COLUMNS IN EACH RECORD ▒▒ ";:GOSUB2340
1570 X=VAL(I8$):PRINT
1580 IFX<1ORX>10THENPRINT"■MAXIMUM IS 10■":GOTO1560
1590 PRINTCHR$(147):C=1
1600 PRINT"          ■THIS FILE IS NAMED "N$    :GOSUB2470
1610 PRINT"REMEMBER THAT COLUMN 1 IS THE ■KEY FIELD■":PRINT
1620 PRINT"WHICH WILL BE USED TO ■IDENTIFY■ RECORD":GOSUB2470
1630 PRINT"STATE ■TITLE■ OF COL"C" ▒▒";:
1640 GOSUB2340    :REM * KEYBOARD INPUT
1650 A$(0,C)=I8$:PRINT
```

```
READY.

1430 PRINT CHR$(147):CLR:DIM A$(50,10)
1440 PRINT TAB(12)"[REV]CREATE RECORD[OFF]":PRINT
1450 GOSUB 2430:REM**LINE
1460 PRINT"WHAT IS FILE NAME [2↑&][SPC]";:GOSUB 2300:REM**KEYBOARD INPU
1470 N$=I8$:PRINT
1480 GOSUB 2430:REM**LINE
1490 PRINT"HOW MANY COLUMNS IN EACH RECORD [2↑&][SPC]";:GOSUB 2300
1500 X=VAL(I8$):PRINT
1510 IF X<1 OR X>10 THEN PRINT"[REV]MAXIMUM IS 10[OFF]":GOTO 1490
1520 PRINT CHR$(147):C=1
1530 PRINT"[REV]THIS FILE IS NAMED ";N$:GOSUB 2430
1540 PRINT"REMEMBER THAT COLUMN 1 IS THE [REV]KEY FIELD[OFF]":PRINT
1550 PRINT"WHICH WILL BE USED TO [REV]IDENTIFY[OFF] RECORDS":GOSUB 243
1560 PRINT"STATE [REV]TITLE[OFF] OF COL"C" [2↑&]";
1570 GOSUB 2300:REM**KEYBOARD INPUT
1580 A$(0,C)=I8$:PRINT
```

A 'before' and 'after' example of a BASIC program listing containing graphics codes.

UK101-SUPERBOARD-TRS80 V.GENIE-MICROTAN-SHARP

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intracept

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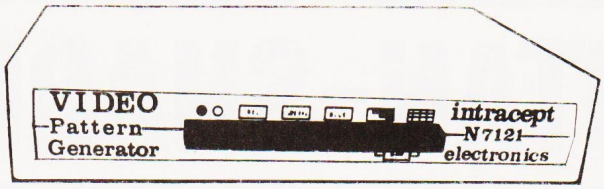

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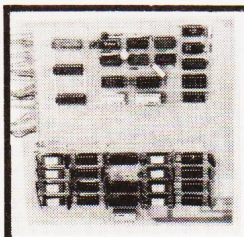

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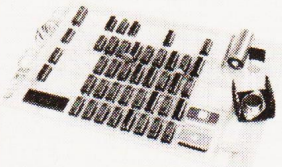

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Dr G J Marshall

Dr Marshall looks at FORTRAN, the oldest high-level language. How has it developed and is it still a viable proposition? Read on for the answers.

The name FORTRAN is an acronym formed by contraction of FORmula TRANslation, and this gives a considerable clue to the nature and purpose of the language. It provides the facility to write instructions resembling formulas and algebraic equations. Developed by IBM and first released in 1957, FORTRAN was the earliest high-level language. The importance of FORTRAN was that it provided an alternative to assembly code, thus offering programmers relief from the tyranny of detail imposed by the latter. High-level language programming, of course, brings with it advantages, including the ease of learning and using the languages, and programs that are less difficult to read, debug and maintain. Against this, programs require more machine time and produce less efficient machine code, both as a result of the translation phase.

The Early Days

The original version of FORTRAN was developed to run on a specific machine — the IBM 704. Consequently, the language was conceived with the assembly code of that machine very much in mind. Some of the restrictions of FORTRAN stem from the special characteristics of that computer. For this reason the design of the FORTRAN language is not logical and consistent, but reflects what could be achieved on a particular machine. By contrast, ALGOL is a formally defined and logically structured language.

The original aims of FORTRAN, as given in the first FORTRAN manual, were to provide a language capable of expressing any problem in numerical computation, particularly problems involving large sets of formulas and many variables. It was admitted that for problems outside the numerical area, FORTRAN might not be ideal. The major areas of application have therefore been scientific and engineering problem-solving. However, the language has been successfully used in a wide variety of application areas.

FORTRAN has evolved and developed through many versions, including FORTRAN II, FORTRAN IV and FORTRAN 77. It was the first language to be formally standardised by the USA Standards Institute (ANSI). During its evolution many additions have been acquired, some intended to make it suitable for non-numerical applications, but the original core of the language has remained. Incidentally, BASIC is derived from FORTRAN II, so BASIC programmers should be wary of mocking FORTRAN.

In recent years, much work has been done on improving FORTRAN compilers with the aim of making them produce more efficient machine code. So-called optimising compilers can even detect and correct inefficiencies in the FORTRAN code, such as unchanging expressions the value of which is continually recomputed within a loop.

The FORTRAN Instruction Repertoire

The brief account of FORTRAN given here relates to standard FORTRAN IV. Because FORTRAN programs were originally presented to computers as packs of punched cards FORTRAN statements have to be prepared to a particular format, even when entered from a terminal or keyboard. Statements must begin in column 7, while columns 1 to 5 are reserved for statement numbers. A 'C' in column 1 indicates that the line is a comment (similar to REM in BASIC) and is to be ignored by the compiler. Any entry in column 6 indicates that the line is a continuation of a previous statement. This 'card image' is illustrated in Fig. 1.

Variable names can be up to six characters long and must begin with a letter, while subsequent characters can be letters or numbers. By default variable names beginning with the letters from I to N inclusive are for integer variables, and the remainder are for real variables. Thus the statement

```
ISIX = 6
```

assigns an integer value to an integer variable, while

```
SIXSIX = 6.6
```

assigns a real value to a real variable. Real numbers are stored in floating point form as fractions between 0.1 and 1.0 multiplied by a power of 10. Other kinds of variables can be used including complex, logical and double precision. The latter are used to obtain high accuracy in the results of numerical calculations. These variables must be declared by using type statements such as

```
COMPLEX Z, W
LOGICAL T1, T2
DOUBLE PRECISION D
```

After these declarations, assignments like the following can be made:

```
T1 = .TRUE.
T2 = I.EQ.3
Z  = CMPLX(1.0, 2.0)
```

The variable T2 is set to true if I equals 3 and to false otherwise. Z is assigned the complex value 1.0 + j2.0.

The functions supplied by FORTRAN include those typically available on a scientific calculator. Among these are sine (SIN), cosine (COS), exponential (EXP) and absolute value (ABS). There are also functions taking complex argu-

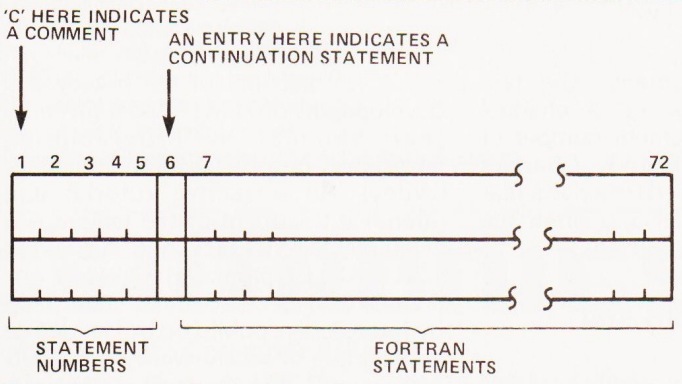


Fig. 1. A programming 'card image'.

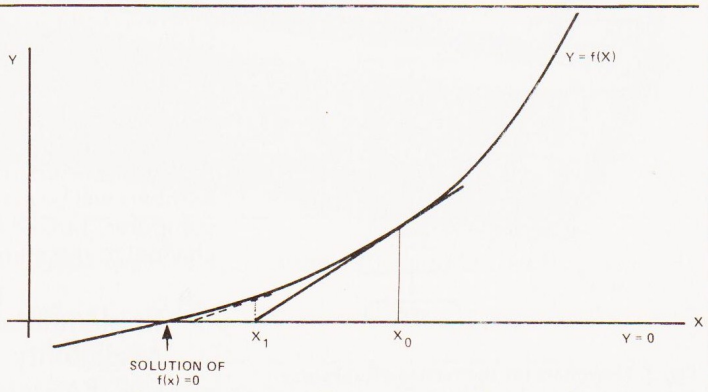


Fig. 2. Graphical illustration of the Newton-Raphson method.

ments and returning complex values.

The repertoire of FORTRAN statements with their key words includes DIMENSION for reserving space for arrays, IF is the conditional statement and DO . . . CONTINUE to demarcate a section of code to be executed repeatedly. READ and WRITE are used for input and output: they *must* be accompanied by FORMAT statements to indicate the form in which data is to be presented or printed out. There is a GOTO statement, and both function and subroutine subprograms are supported.

A Typical FORTRAN Program

A FORTRAN program for a problem in numerical analysis is presented below. This type of application is typical of those for which FORTRAN was intended.

The Newton-Raphson method is a technique for solving equations. Any equation containing a single unknown, x, can be represented by

$$f(x) = 0$$

and can be solved approximately by plotting the curves $y = f(x)$ and $y = 0$ to determine the value of x, say $x = x_0$, at which they cross. This value of x makes f(x) equal to zero, and so satisfies the equation. This is illustrated in Fig. 2. The Newton-Raphson method can improve this approximate solution to any required accuracy. The method, again illustrated in Fig. 2, is to draw the tangent to the curve $y = f(x)$ at $x = x_0$ and to take the value where the tangent cuts the x-axis, call it $x = x_1$, as an improved approximation. This process can be repeated as often as necessary to give any required accuracy. The Newton-Raphson formula describing this process is

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$$

A flow chart for the process is given in Fig. 3.

Now consider the precisely defined problem of using the Newton-Raphson method to find, accurate to 5 decimal places, the root near $x = 2$ of the equation

$$\sin x + 2 - e^x = 0$$

The Newton-Raphson formula becomes

$$x_1 = - \frac{\sin x_0 + 2 - e^{x_0}}{\cos x_0 - e^{x_0}}$$

The FORTRAN program based on Fig. 3 and incorporating this formula is listed below:

```
      XOLD = 2.0
      K = 1
5     EX = EXP(XOLD)
      XNEW = XOLD-(SIN(XOLD)+2.0-EX)/(COS(XOLD)-EX)
      WRITE(5, 100) K, XNEW
      ERROR = ABS(XOLD-XNEW)
      IF(ERROR.LT.10E-6)GOTO 6
      XOLD = XNEW
      K = K+1
      GOTO 5
6     WRITE(5, 101) XNEW
100   FORMAT(1X, 'APPROXIMATION NUMBER', I3, ' IS', F12.6)
101   FORMAT(1X, 'THE RESULT IS', F12.5)
      STOP
      END
```

The output produced by this program is:

```
APPROXIMATION NUMBER  1 IS  1.426055
APPROXIMATION NUMBER  2 IS  1.134193
APPROXIMATION NUMBER  3 IS  1.058807
APPROXIMATION NUMBER  4 IS  1.054144
APPROXIMATION NUMBER  5 IS  1.054127
APPROXIMATION NUMBER  6 IS  1.054127
THE RESULT IS         1.05413
STOP
```

In the WRITE statements, the two numbers in brackets are a channel number and the statement number of the associated FORMAT. Channel numbers will be assigned for a particular computer, but channel 5 is often the channel to the current device.

Implementations And Availability

FORTRAN is fairly readily available for micros. FORTRAN IV is available under CP/M, so that it can be run on machines such as the Sharp MZ-80. FORTRAN 77 is available for Apples, and Microsoft FORTRAN IV can be run on TRS 80's.

Conclusion

As the first high-level language, FORTRAN clearly has the greatest historical importance among high-level languages. However, considering that the design of the language is far from ideal, it may seem surprising that it has survived so strongly to the present day. There are now undoubtedly many superior languages. There are also many good reasons why FORTRAN has survived so well. These include the vested interests of programmers who have learned the language, and the fact that an awful lot of software has been developed in FORTRAN for scientific and engineering applications. The graphics package GINO-F is one example of an applications package written in FORTRAN which is, and will doubtless continue to be, widely used.

Further Reading

A full account of the history and development of FORTRAN is given by Jean Sammet in 'Programming languages: history and fundamentals' (Wiley). An attractive tutorial and reference treatment of the language is given by D D McCracken in 'A guide to FORTRAN IV programming' (2nd edition) (Wiley). See also 'Basic FORTRAN' by James Coan, published by Hayden, as an example of recent work on the subject.

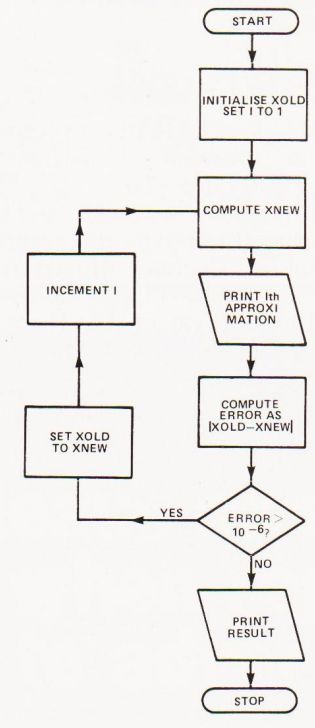
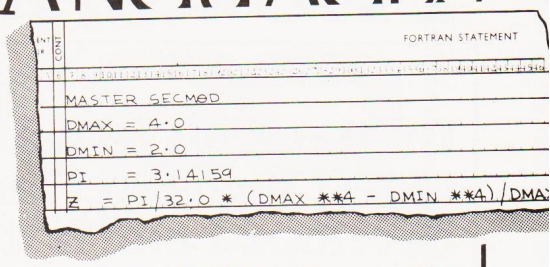


Fig. 3. Flowchart for the Newton-Raphson program.



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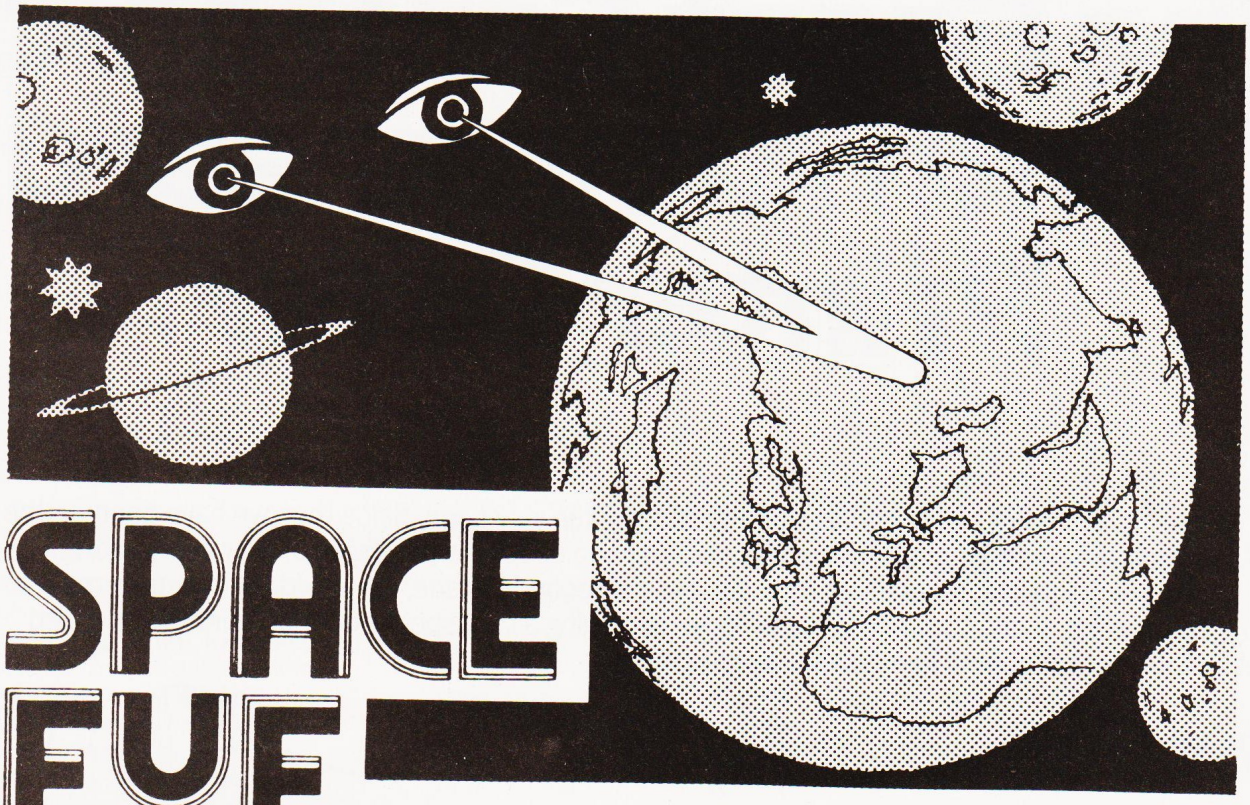

SPACE EYE

When you come to think of it, computer programs are rather like films, the viewer or operator normally takes the part of the good guy. In this game the roles are transposed. You take the part of a Vogon space commander and your mission is to destroy Earth, the Moon, Mars or Jupiter, before the surface defences shoot you down with their missiles. So far, apart from the roles being somewhat transposed, we have an ordinary space shooting game. The importance of this game is hinted at by its title — "Space Eye", for during the play of the game, that is to say during the attack on the planet, the centre of the screen is taken up by a fantastically realistic view of the planet underneath. Obviously the topography of Earth is better known to us than that of the other planets, so it is with the Earth attack that one gets the most realism. One almost gets the actual feeling of passing over the Earth as the Continents pass below the Space Eye. The impression is quite uncanny and really has to be seen to be appreciated. The graphics for the various planets are so extensive that they cannot be included in the program and are supplied in the form of datafiles which the program inputs. In other words, when you have chosen the planet which you wish to attack, the data for that particular planet is fed in from either tape or disk.

Here and there on the planet's surface are enemy bases which have to be destroyed. Intermingled with them are the enemy's rocket sites which will, with uncanny accuracy, damage your vessel with their missiles. Although this shooting back and forth is good fun, the value of the program as we have said, lays in the realism of the image of Earth passing beneath the Space Eye. As we are not so familiar with the other planets, the view passing beneath the Space Eye has been annotated with the names of the most important features and in the case of Jupiter and Mars, some of the Moons are displayed. During an attack the surface of the planet passes beneath the Space Eye as we have described, but an added feature is that the user has the option of displaying on the screen the planet over which he is orbiting. This can come in handy if you are not used to orbiting around Mars and Jupiter!

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BUBBLE MEMORIES

Brian Dance

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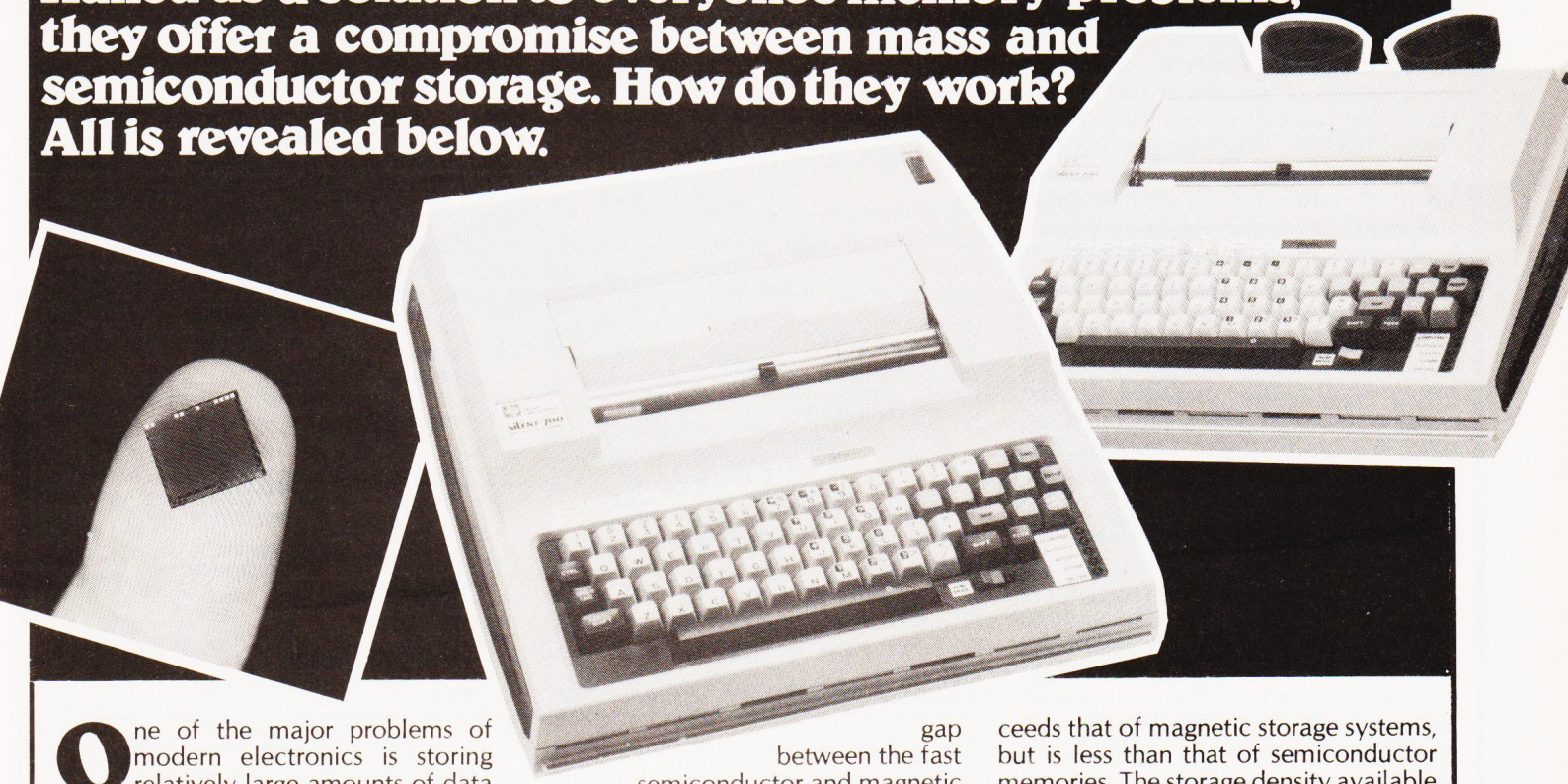


One of the major problems of modern electronics is storing relatively large amounts of data economically in small memory packages; this applies whether one is designing a small pocket calculator, a data terminal, a large computer or a digital telephone exchange.

Semiconductor memory devices provide rapid access to somewhat limited amounts of stored data but, in most types of such random access memories, the data is lost in the case of a power failure or if the equipment is switched off. It is convenient to store much larger amounts of information on magnetic tape or a floppy disc, but access to the information is far slower than in the case of semiconductor memory. Although the cost per unit data stored in magnetic systems is low, reliability is not really adequate for some applications -- especially spacecraft data storage.

Great efforts have therefore been made to develop memory devices which can store large amounts of data in a relatively small volume at low cost per bit — preferably without the use of motors or moving parts. These reduce reliability, especially in conditions of severe vibration or in difficult environments such as corrosive atmospheres.

Bubble memories satisfy many of these requirements and also have the great advantage of non-volatility (the data stored in the memory device is *not* lost in the event of the power being disconnected).

Speed

The bubble memory can fill the vital gap between the fast semiconductor and magnetic storage systems. Currently available bubble devices have typical access times of the order of 1 mS; although this is much slower than that of semiconductor memories, which have access times of 1 uS or less. It is much faster than the floppy disc access time of perhaps 100 mS. Magnetic tape cartridges and cassettes have still longer access times — often over a minute (see Fig. 1).

Cost is a vital consideration in memory devices which are to be used in quantity. The cost per binary digit (bit) of storage space in a bubble memory exceeds that of magnetic storage systems, but is less than that of semiconductor memories. The storage density available in a bubble memory (amount of data storage per unit volume) exceeds that of a semiconductor memory, but is less than that of magnetic systems. However, bubble memory storage density has considerably increased recently and hopefully will continue.

What Is A Bubble?

Unfortunately the term 'magnetic bubble' is rather misleading, since it used to refer to very small cylindrical magnetic regions or domains in a thin film of material. These domains are magnetically polarised in the opposite

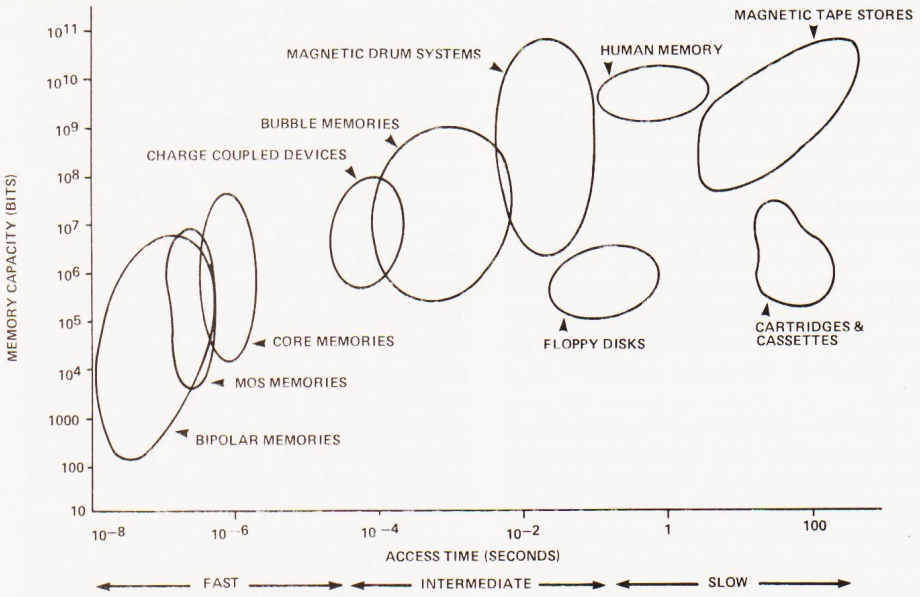


Fig.1. Memory capacity compared with access time

direction to the remainder of the film. This film consists of a special garnet crystal which is uniform and has the required magnetic properties. Typically, the thickness of this garnet film is only about one twentieth the thickness of a human hair.The magnetic bubbles can be moved about in the film by means of electrical pulses applied to the bubble memory connections. The presence of a bubble corresponds to the binary digit '1' and the absence of a bubble at a certain point to binary digit '0'.

The techniques involved in the manufacture of bubble memory devices are similar to those required for the manufacture of complex integrated circuits. It is not therefore surprising that many of the world's semiconductor giants have become involved in the development and manufacture of bubble memories.

Structure

The structure of the Texas Instruments bubble memory is shown in the exploded view of Fig. 2. Two coils with mutually perpendicular axes are wound on the magnetic bubble chip so that they can be fed with a current which will produce the required rotating magnetic field which moves the bubbles.

The two permanent magnets above and below the thin garnet film contained in the coils produce a fairly uniform magnetic field perpendicular to the garnet film. The bubble memory device is enclosed in a magnetic shield so that its operation is unaffected by any low intensity magnetic fields which may be present in its environment. As indicated in Fig. 2, a bubble memory device requires quite a number of associated intergrated circuits to develop the current pulses required to operate its coils etc.

The thin film material of a bubble memory is easily magnetised in a plane perpendicular to that of the film. In the absence of any magnetic field, random 'serpentine' domains are present. As the magnetic bias field is increased by bringing the two permanent magnets up to the film, the domains that oppose the field shrink in size (as shown in Fig. 3) until they form small cylindrical domains or 'bubbles'. As these bubbles are magnetic dipoles, they interact strongly with one another and it is therefore normal practice to employ a bubble spacing of not less than four times the diameter of a bubble.

Bubble diameters are typically a few micrometres, but there are intensive efforts being made to construct bubble memories with smaller bubbles so that the amount of information which can be stored in a given chip area is increased. However, special techniques are required to deposit very fine lines on the chip to reduce bubble diameters, the minimum diameter obtained so far being 0.4 uM.

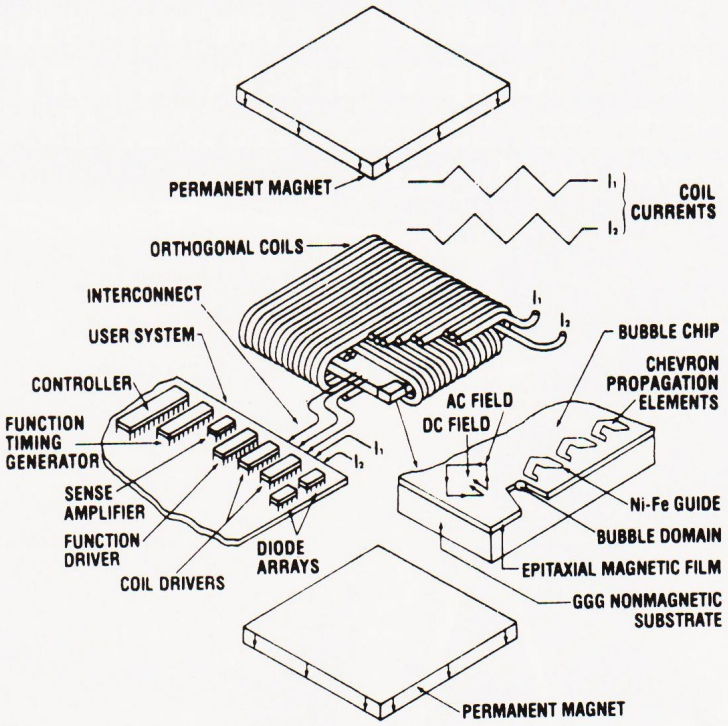


Fig.2. An exploded bubble device and its associated components

Propagation

Propagation is the term given to the process of moving bubbles from one location to the next position. The paths in which the bubbles move are controlled by minute patterns of a soft magnetic 'permalloy' material deposited on the chip by photo-lithographic techniques. The patterns can be made to act as small electromagnets whose polarity is controlled by the external rotating magnetic field generated by the perpendicular coils wound around the chip.

One bubble memory pattern which is widely used is the asymmetric chevron pattern shown in Fig. 4, but 'T', 'Y', contiguous disc and symmetrical chevron patterns are sometimes employed. The pattern of soft magnetic material is deposited on the surface of the chip above the thin magnetic film layer.

Bubbles can be generated in the thin film by passing a pulse of current through a microscopic metallised one-turn loop located on a secondary layer immediately above the magnetic film on the surface of the chip. If the current pulse is of a suitable amplitude and polarity, it will produce a local vertical magnetic field of a polarity opposite to that produced by the permanent magnets and creates the bubble in that region.

A rotating magnetic field generated by the perpendicular coils around the chip can produce the magnetic polarities in the chevron pattern shown in Fig. 4.

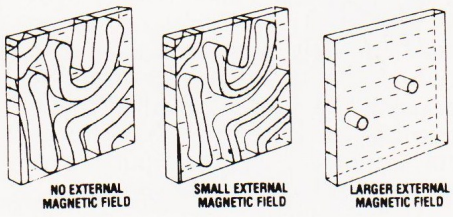


Fig.3. Bubble formation in a thin garnet film

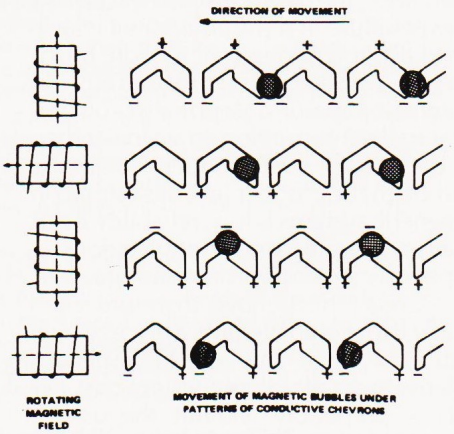


Fig.4. The asymetric chevron pattern formed on the garnet film

These patterns can attract the bubbles and cause them to move to an adjacent position, as shown for the two bubbles in Fig. 4.

In a practical device one must be able to detect whether a bubble is present at any position. A pattern of chevrons is placed at right angles to the output track and is used as a bubble detector. This output chevron pattern

causes the bubbles to elongate and, as they pass over a permalloy detector pattern, the magnetic field changes and this produces a change in the resistance of the permalloy elements. Thus detection is by a magnetoresistive effect. Two identical detector elements are placed on each chip and are used as two of the sides of a bridge circuit (Fig. 5). A bubble passing over one of these detectors produces the resistance change, which then appears as a signal of a few mV in the output in the bridge circuit.

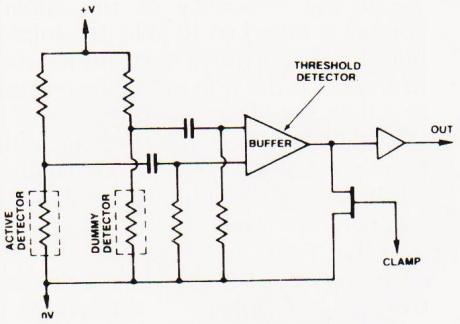


Fig.5. A typical bubble detection circuit

Memory Organisation

One type of bubble memory employs a single loop, as shown in Fig. 6, the pattern of bubbles and blank spaces moving around the loop step-by-step when commanded by the rotating magnetic field from the perpendicular coils. The positions shown in Fig. 6 in the loop correspond to locations on the chevron pattern of the actual bubble memory.

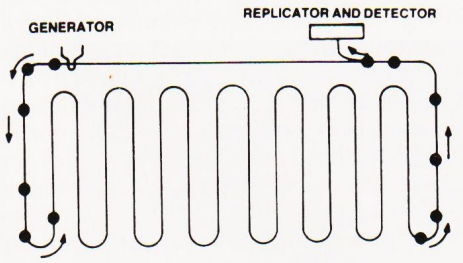


Fig.6. A single loop structure

Although this single loop memory architecture is the simplest possible structure, it suffers from two principal disadvantages. The main problem is that when any bubble position has passed through the generator or detector, it must circulate around the whole of the loop before it can be altered or read out again. Access times to obtain information stored in such a loop are therefore very long, since modern bubble memories can store up to a million bits of data and must therefore have at least this number of bubble positions.

In addition, a fault at any point in the single loop can result in the complete memory chip being quite useless. As it is difficult to produce bubble memories with a large data storage capacity *and* a high probability that every bubble storage position will operate satisfactorily, such a loop structure would result in a low yield of good devices. Such a low yield would inevitably result in a relatively high price per device.

For these reasons the manufacturers of high capacity bubble memory devices normally prefer to use a type of major-minor loop architecture such as that shown in Fig. 7. Bubbles are generated and detected only in the major loop. Any bubble generated can be transferred to a minor loop where it can circulate until it is to be read out from the memory. It must be transferred to the major loop before readout can take place.

When data is to be entered, current pulses in a loop wire enter the bit pattern into the major loop. It is then moved along the major loop by pulses to the perpendicular coils until the first data bit in this loop is aligned with the most remote minor loop and each of the other bits is adjacent to one of the other minor loops.

Any old data in such a bubble memory must first be removed by a destructive read operation before new data can be entered into the memory. Destructive read operations are effected by transferring the bubbles from the minor loops and running them into the permalloy guard rail surrounding most bubble devices, so that they are annihilated.

Reading of information from the minor loops is effected by rotating the bubbles in the minor loops until the required data is adjacent to the major loop. The block of data is then transferred in parallel (that is, simultaneously) to the major loop. The data block then moves through the major loop to the replicator-detector. The original data stream in the major loop continues to rotate in the loop until it reaches the appropriate minor loop, when transfer takes place so as to save the data for any further work which may be required.

In bubble devices using major-minor loop structure, a small number of the minor loops may be defective without the device operation being impaired, since enough minor loops are included on each chip to allow for a few defective loops to be redundant. Defective minor loops are found during device tests and are not used, so that a high device yield, and hence a lower price, is obtained. In addition, the use of major-minor loop structure greatly reduces data access time, since the bubbles have to be moved through only a relatively small number of positions before read or write operations can take place.

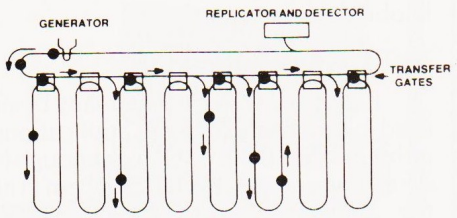


Fig.7. A major-minor loop structure

Availability

One-megabit bubble memory devices are readily available, although they are not cheap, but devices with a somewhat smaller capacity are more common. There is considerable demand for devices with a greater storage capacity and some people have predicted that devices able to store over 100 megabits will be available by the end of the 1980s. By this time it is expected that the world markets for bubble memories will be worth perhaps $1000 million per annum, so it is no wonder that the semiconductor manufacturers have invested heavily in bubble memory development and production.

US manufacturers are well ahead in the bubble memory race, since they have developed these devices from their semiconductor production techniques. Japanese manufacturers have also invested heavily in the bubble memory field, but Plessey is currently the only European manufacturer producing bubble memories.

Let us consider a few of the currently available devices. Texas Instruments produce a one-megabit device with a 0.965 cm^2 chip area. It has a major-minor loop structure, but is divided into two identical sections, each of which has 256 loops of 2048 bits each for data storage. In addition, there are 26 redundant loops and 18 loops for error correction information. This manufacturer also offers devices with 512 kilobit and 256 kilobit capacity.

Intel produce a bubble memory of one-megabit capacity, having 256 data storage loops, each with a capacity of 4096 bits. Thus it offers 1,048,576 bits of storage space, but up to an additional 48 loops can be defective and therefore redundant. Transfer time is 6.5 mS at a nominal 50 kHz rate.

Rockwell International produce a 256 kilobit bubble memory, having 260 data loops each with 1025 storage positions. Another 22 loops are available to provide minor loop redundancy. Four of the 260 loops required for the system information storage and are not available for data storage. The operating power required is less than 1 W. The three parts of this device are shown in Fig. 8. Rockwell also produce one-megabit memory boards containing four of their 256

kilobit devices.

Applications

Bubble memories are already being used in a quite a number of applications, although their price is still high enough to deter many people from using them in all the applications for which they are technically suitable. High density devices have been available only since about 1978, when Texas Instruments introduced a 254 kilobit bubble memory.

Bubble memories with a high storage capacity have proved of value in space vehicles as they are very light in weight for a given capacity; non-volatility and minimum power consumption are also important in this application.

In telephone exchanges bubble memories can be used to hold 'recorded' messages, which can be converted into an audio signal and played over the telephone to a caller whenever this is required. Bell Laboratories of the US, where the bubble memory was first invented in 1967, have developed equipment for use by the Bell Telephone System. Announcements such as "we're sorry, but the number you have called is not working..." have been produced by Bell for many years with bubble memory storage. However, the major telephone application seems to be in giant telephone exchanges to route calls, where the major attraction of bubble memory devices is their high reliability and low maintenance costs. They are now in use in many telephone systems in various parts of the world.

In the general field of computer equipment (including the replacement of the floppy disc), bubble memories have great potential, but at present they do not seem really cost-competitive compared with conventional memory systems, especially when one takes into account the fact that the incorporation of these devices into mainframe computers would involve a great deal of equipment redesign which would be quite expensive. Manufacturers such as IBM have not yet used bubble memories in their computers, although they are one of the world's foremost research establishments in the field.

In the computer field bubble memories are currently more suited for use in peripherals, such as display terminals, and in smaller special-purpose computers for military and other purposes, where their robust properties and other features are especially suitable. Eventually we may see large computers specifically designed to make optimum use of bubble memory devices. Similarly, bubble memories are likely to be used more and more in industrial control systems and factories, etc.

One may also expect bubble memories to be more widely used in the data logging field, including supermarket sales data, geological and oceanographic surveys, where reliability and portability may be more critical than initial cost.

Future Developments

As with most devices, the widespread use of bubble memories will be largely controlled by their price, while this will be largely determined by the numbers used. It is the old story of what came first, the chicken or the egg! The development of smaller bubbles and therefore of denser devices will doubtless assist in the more widespread use of bubble devices for some purposes.

It is interesting to note that memories employing light bubbles have been developed. It is hoped that they will eventually enable low-cost, high density memory sytems to be produced using the new technology. Light bubble memories involve the formation of images in manganese-doped zinc sulphide films by stimulating specified areas with a light beam, an electron beam or an alternating addressing voltage to the area, using cross metallic lines deposited on the film; the effect of the addressing voltage is to induce light emission from the chosen region.

If the frequency of the applied voltage is raised to 10 kHz, the minute bubbles of light move from one location to another in discrete steps. The creation of a light bubble at one point seems to take place at about the same time as the bubble on an adjacent site is extinguished. If two light bubbles approach one another, they repel.

The light bubbles can be seen emerging from the appropriate areas of the zinc sulphide film under a microscope. The full theory of the generation of bubbles in the film is not yet known, but it seems that they are connected with the microscopic defects in the polycrystalline structure of the zinc sulphide film. Nevertheless, it will doubtless be some time before devices using such light bubbles become commercially available, even if all the technological problems are overcome.

Conclusion

Bubble memories are attractive devices for use when one requires a medium speed memory system for storing moderately large amounts of data at prices which are currently in the middle of the memory price range for each bit of memory capacity (Fig. 9). Some devices have been developed which do not require the pair of perpendicular coils and these should be very attractive, at least in principle, since the coil operation limits the maximum operating speed, due to eddy currents and skin effect losses in the metal of the device.

Our thanks are due to Rockwell and Texas Instruments for their assistance in the preparation of this article. The heading photo is of two Texas Instruments data terminals which use bubble memory technology.

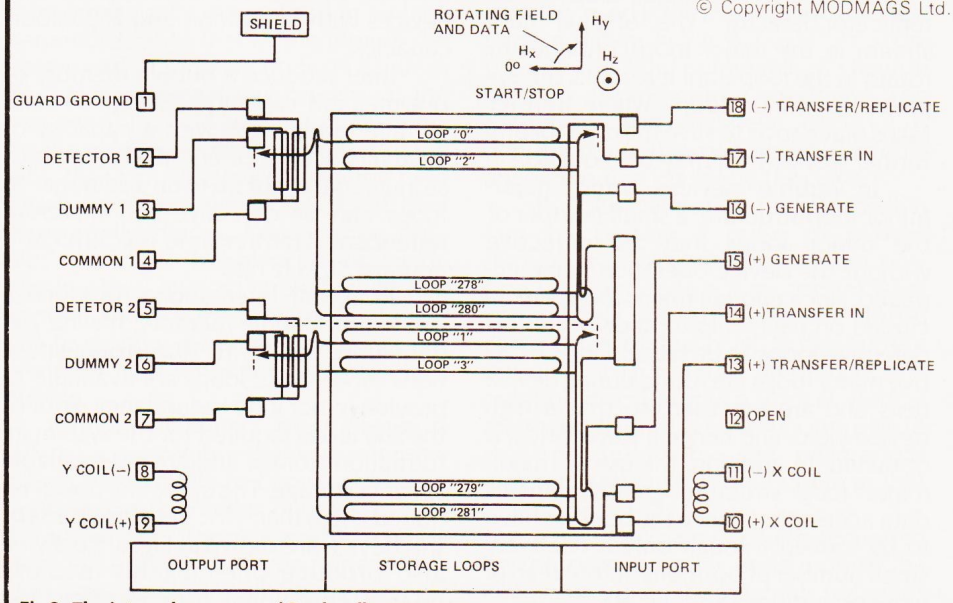


Fig.8. The internal structure of Rockwell's RBM 256

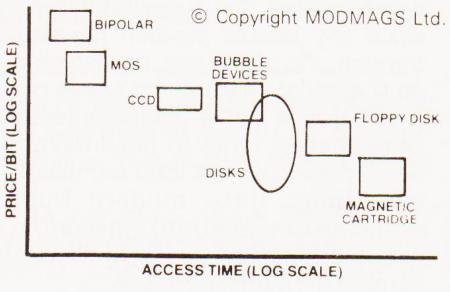


Fig.9. Access time compared to price per unit storage

FLEXIBLE STORAGE

D S Peckett

If you can't afford a floppy disc and are dissatisfied with your cassette interface then the Stringy Floppy appears to offer a viable alternative.

It's probably the experience of anyone who has used a micro system for any length of time that cassette-based storage can be incredibly frustrating. It is very slow, the serial access makes file-handling extremely cumbersome, and its integrity is questionable (why else are PET programs recorded and played-back twice?). To add to this list of complaints, TRS-80 users also have their volume-setting trials and tribulations.

As you'll know, if you've ever used them, discs (pretty-well) solve all these problems at a stroke. The catch, of course, is that disc systems are costly, both in ££££s and in memory space.

The Aculab Floppy Tape system is offered as a "tape that behaves like a disc" for TRS-80 Model 1, Level II and Video Genie computers. At somewhere between a third and a quarter of the cost of a disc set-up, it certainly sounded like an answer to my problems — so how has it actually shaped up?

Hardware

First of all, what do you get for your money? The tape drive itself is in a neat metal case, measuring about 5¾"x 3" x 6¾". Inside the case is the very simple transport with its single read/write head, and a single PCB carrying a 2K PROM and assorted components to make the system work.

The drive has a short 40 (TRS-80) or 50 (Video Genie) way ribbon cable coming out of the back, terminated by a suitable edge connector to link to the computer's expansion interface. There is also an edge connector for daisy-chaining up to seven slave drives, and the lead to the power supply unit. The PSU has an integral 13 A plug — a little awkward if you don't have a 13 A socket!

The basic package also includes a selection of 10 floppy tapes ('wafers'); my immediate impression was that they were tiny. They even make a *cassette* look big. The tape works on a continuous-loop principle, like the old 8-track cartridges, and a wafer can hold up to 75 ft of the approximately 0.1" wide CrO_2 tape. The wafers are available in sizes from 5' to 75' and, as we'll see, they have proved to be the system's weakest point.

Data is recorded on the tape at about 2250 bpi (bits per inch), although certified up to 3200 bpi, in a single-density FM soft-sectored format, with parity and checksum error detection. With a transport speed of around 8 ips, this gives a data rate of around 9K baud. For comparison, the TRS-80 cassette system works at 500 baud.

Finally, the package also contains a 16 page, A4 size manual. The manual is well laid out, but contains so much information that it demands very close study. Although I have a fair amount of assembly-language experience, I found the section on machine-language programming particularly hard to follow. Nevertheless, the manual contains almost everything that you might want to know, with the notable exception of any electrical or electronic data on the hardware.

Connecting Up

I found that the system was simplicity itself to connect up, once I had read the instructions carefully. The only difficulty was that the ribbon cable was very short, and the only place that I could comfortably put the drive was perched on top of my Video Genie. This is fine with a single drive, but with more than one, or with a TRS-80, things might be a little awkward. There are obviously problems associated with making the cable longer, but just a few extra inches would make a big difference.

I switched everything on, and booted up the floppy tape operating system with 'SYSTEM' and '/12345' commands (what a well-chosen start address!) and the system header came straight up on my monitor with no fuss at all.

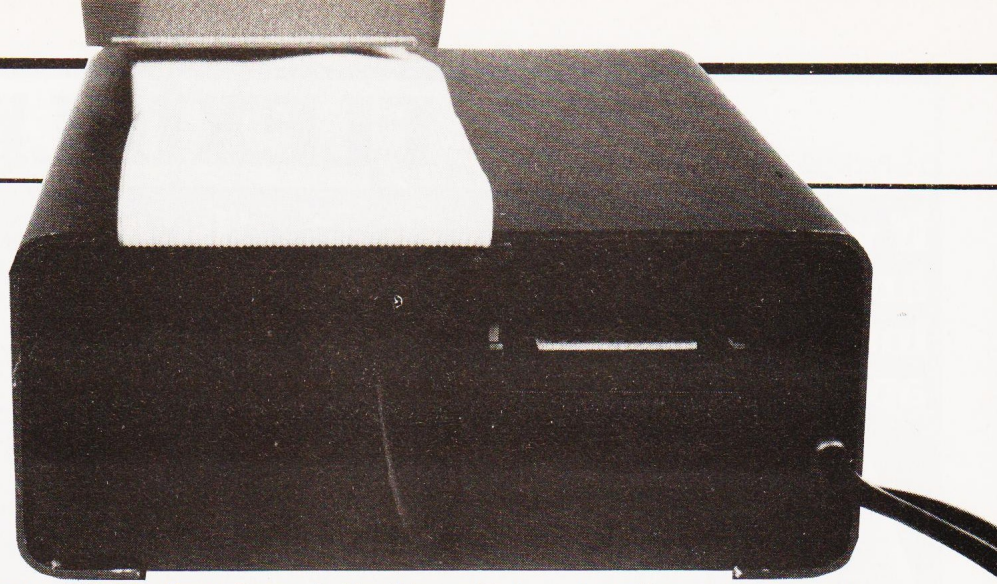
The System In Use

The floppy tape master drive, which is the first one you buy, incorporates a 2K PROM containing the new operating system. This cunningly fits into a gap in the TRS-80/Video Genie memory-map between 3000H and 37DDH. This slot is normally unused, and lies between the top of the Level II BASIC Interpreter, and the I/O space for various peripherals.

The operating system itself, therefore, takes up no RAM space. However, the system does use 1¼ K of RAM at the bottom of memory for its scratchpad area, file directory and a 256 byte I/O buffer. As a result, programs will normally start at 4800H, rather than the usual 42E9H. This both reduces the maximum size of the programs you can get in, and makes life difficult for machine code programs that *must* go below 4800H. It's not too difficult to get around this problem though, as I will explain later.

As well as providing all the control facilities for the tape, the operating system has a built-in keyboard debounce routine. This makes life much more pleasant. As an overall comment, I found the operating system generally easy to use and completely uncrashable — at least, it resisted all my best efforts.

Data is stored in 256-byte sectors. The system can handle up to 252 sectors in a single tape; a 75' tape holds this many, shorter tapes have proportionately fewer. Regardless of the number of sectors, the system allows up to 32 files, each of any size (up to the maximum number of spare sectors of course). A file can be any one of three types: BASIC, machine-code (strictly a memory dump,



The rear end of the Floppy Tape unit. The ribbon cable is terminated in a TRS-80 compatible edge connector. The second connector is for linking to 'slave' drives.

but intended for machine-code programs) or data.

In the case of data files, which is where the floppy tape is claimed to really score, the disc analogy is maintained by referring to each sector of a file as a 'record'. Individual records in a file can be read and written independently.

Facilities And Commands

All the extra floppy tape commands start with a '@', and have the format:

@COMMAND"FILENAME/EXT:d"

The file name can have up to eight characters, with no spaces, and must be followed by a three-character extension field. Unlike a normal disc operating system, the floppy tape system does not actually use the extension to identify the file type — it is merely there for your convenience. If you don't use it, the system defaults to a "three-null" extension.

Actually, this is helpful, because the extension can be anything that assists you — '/BAS', '/DAT', '/BIN', etc. The final ':d' defines the drive number (0-7); it's an optional field, and defaults to zero. If you have only one drive, therefore, you don't have to add it. A useful feature is that you can use a suitably-defined string variable in place of the file name — this can make life easier, particularly when handling data files.

The main operations which the system can perform on files are to @SAVE, @LOAD and @RUN them. The names are self-explanatory and @RUN is particularly valuable because it loads, and then automatically starts running, a program (it will only start a machine-code program if you have @SAVEd as start address). Type '@RUN "STARTREK/BAS"', take a sip of your coffee, and the Klingons are there — firing at you!

A useful command for BASIC files is @MERGE. This loads up a second BASIC program to be attached to, and maybe called by, a program that's already in memory. Since the floppy tape commands can be used within a BASIC program, this means that, in principle anyway, a segment could be @MERGEd into an already-running program if you did not mind corrupting the variable area. It's not a very clever merge though — it's really @APPEND. The second program is simply tacked on to the end of the existing program, with no attempt to sort out line numbers, etc. Its main use is for putting together a program from a series of standard subroutines (if the line numbers don't clash. . .).

The system also provides three utility commands — @KILL, @NEW and @LIST. The first one is the only one to take a full file name, and deletes that file from the tape, freeing its sectors to be loaded with other data. The second two only require the ':d' suffix, and then only if you have more than one drive. @NEW formats a new tape into blank sectors, and creates an empty directory. This is essential before you can use the tape.

The function of @LIST is to read and display the tape's directory, ie to show the files that are on the tape. You must perform an @LIST whenever you load a tape into a drive. This puts the directory into RAM so that the operating system can find your files when you call them up. Once the directory is in, it's kept up to date with any changes you may make.

Data Handling

I've deliberately left to the end the two data-handling commands @GET and @PUT. These transfer a defined sector to or from the system's 256-byte I/O buffer. To my mind, these are the floppy tape's clumsiest features, since it is left entirely up to you how to get the data into and out of the buffer. (The handbook implies that this gives "complete flexibility".)

The manual gives some useful hints for data handling, of which the most valuable is probably the suggestion to treat *all* data as strings. Before an @PUT, each character, or character derived from numerical data, must be POKEd into the buffer — obviously this means that you have to write a suitable routine. Alphanumeric data is easy to handle, and integers aren't too bad if you realise that each one uses two bytes, and single bytes can be converted to characters by CHR$(x).

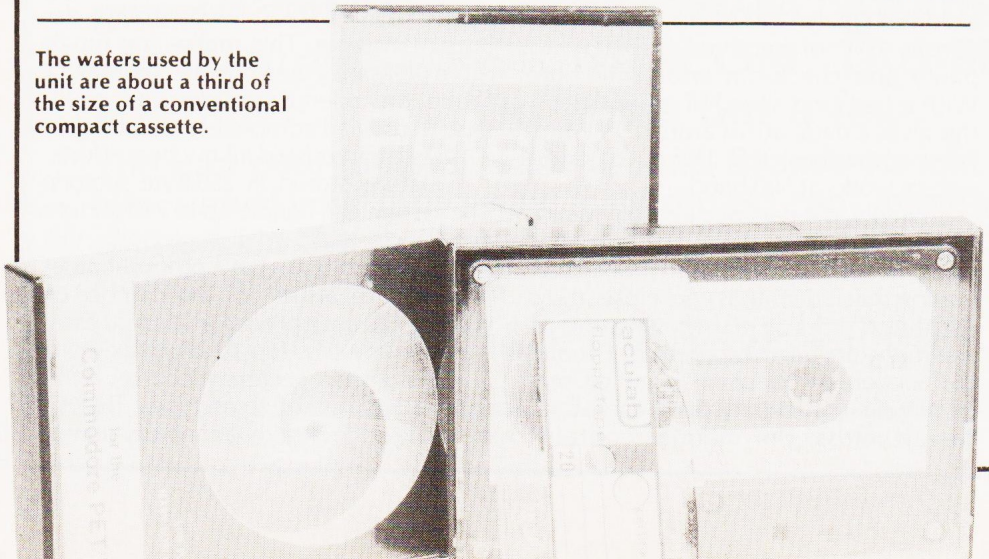
Floating point numbers are hardest — you have to STR$(x) them, and then POKE them, one character at a time. With floating point numbers, it might be wise to use a separator (eg '!') between the strings representing each number to make it easier to separate them later. If you read back "2.473987.00" what does it mean? "2.4739!87.00!" is much clearer. Alternatively, you could PEEK directly into RAM by way of VARPTR, and read the four bytes holding the number.

An @GET loads the defined sector into the buffer. The handbook gives a very cunning and fast way of moving this into any string variable, from where you can split it up into its different fields. You have to be careful here — the floppy tape buffer uses 256-byte sectors while a Level II string has a maximum length of 255 characters. Either don't fill each sector completely, or read each one into two strings.

My criticism is that, while it is not that difficult to use the system's data-handling facility, it is needlessly clumsy. You have to solve the problems of using @GET and @PUT before you can get down to solving the real problems that you are writing the program for.

A final note about all the '@xxx'

The wafers used by the unit are about a third of the size of a conventional compact cassette.



commands. Any of them can be used from within a BASIC program, handing control back to that program when they are done. This, in turn, means that the commands can be chained together as much as you want. Very useful.

Tape Performance

When I first received my system, I soon found that it was not working properly. Tapes that had been OK suddenly weren't, and others just could not be initialized. I returned the system to Aculab just before Christmas.

It was returned to me on 9 Jan; allowing for the company's Christmas closedown, this represented a one-week turnround. Since I did not reveal that I was doing this review, this was a more than adequate response; however, since I had been given verbal indications that it would be faster, I had an irritating wait.

It turned out that I had suffered two problems — a defective read/write head and a batch of faulty tapes. With this sorted out, the system appeared to work properly, but after a few weeks the read errors started up again, particularly with tapes that had made 50 or so passes.

It is now clear that Aculab has been experiencing severe difficulties with its tape suppliers. Recent batches of tape have had a sub-standard coating that cannot tolerate the multiple passes involved in floppy tape operation. The problem is made harder to identify by the fact that faulty tapes may actually work perfectly for some time before the defect shows itself.

Aculab has stated that it is setting up deliveries of tape from a new supplier; the tape should have a stronger coating. The company is prepared to exchange faulty tapes, and by the time that this article appears, should have received its first batch of the new formulation.

Directory Location

As I mentioned above, putting the directory at the bottom of the user RAM is normally OK, but can cause problems with large and/or data-intensive BASIC programs, and with machine-code programs that must start at low addresses.

Fortunately, it's not too difficult to move the directory. Whenever it might be in the way, you can use a short BASIC utility to relocate it to the top of memory before you load the program you want:

```
10 POKE 16813,0:POKE 16814,120: 'DIR.
   POINTER TO 7800H
20 POKE 30689,0:@LIST: 'MOVE
   DIRECTORY
30 POKE 16548,233:POKE 16549,66:
   'START-OF-BASIC POINTER TO 42E9H
40 @RUN"program/ext":'LOAD AND
   RUN PROGRAM
```

This is suitable for both BASIC and machine-code programs. For instance, my editor/assembler is stored as 'EDTASM/BIN', and I load and run it with a version of this utility called 'EDTASM/RUN'.

Once the target program is running its data may well overwrite the directory. This does not matter until you come to use the tape again; obviously, you must @LIST first. The technique does *not* work with programs that would overwrite the directory while they were being loaded. This means that I still have to load my 'Adventures' from cassette.

A word of caution about relocating the directory. Particularly if you are going to @SAVE a machine-code program, you must be very careful how you get back to BASIC from the SYSTEM level. I found that the best sequence was to:

a. Boot up the floppy tape.
b. POKE into 16813 and 16814 to move the directory, and @LIST.
c. Go to SYSTEM and load, but *don't* run, the machine-code.
d. Leap back to BASIC with a '/114 ENTER'.

This way, you go back to the operating system without disturbing anything. You can then @SAVE immediately. If you don't know the autostart address for the program, find it with:

```
PRINT 256*PEEK(16608) + PEEK(16607)
```

Final Impressions

As well as its crucial tape problem, the floppy tape system has a few other clumsy features, but it also offers major benefits in flexibility and speed. But is it a good bet overall? I think that the answer is a qualified "yes".

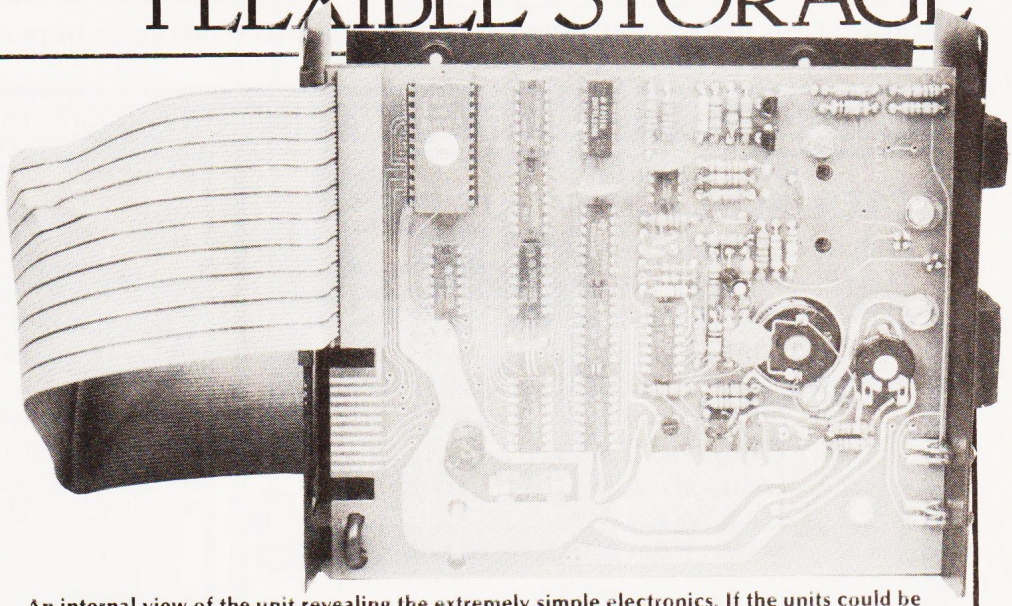
In particular, it is much faster than using cassettes, which is what I was really looking for when I bought it. As an example, I have a (successful) football pools program that uses a very large data base. Using cassettes, it took about 20 minutes to load and verify the program and data, assuming that there were no errors; it took as long to shut the system down. The floppy tape allows me to have everything up and running in three minutes, and shut down in two.

It's worth noting at this point that, when you have to do a lot of reading and/or writing of files, program run-time is virtually proportional to the tape cycle time. Since a 5' tape cycles in 7 secs, while a 75' tape needs nearly 2 mins, it's best always to use the shortest tapes you can.

There are a few minor niggles, the error messages are awkward. All errors appear as 'FD ERROR IN . . . ', and you have to read the actual error code via a PEEK(17396). It would be much more convenient to have them displayed directly. You also can't use CLOAD? when the directory is at its normal position at the bottom of RAM. It apparently only works when the BASIC program starts at 42E9H, implying that the directory has been moved.

The drive does not really tell you enough about what it is doing. At the very least, I would like to see a power 'ON' LED — it's all too easy to leave it switched on. I also find the flashing '*' during a normal 'CLOAD' very useful, the floppy tape does not give any visual feedback of this kind. Surely it would not be difficult to add another LED to show when data was actually being transferred from tape to computer?

In conclusion, although the floppy tape system has a number of awkward features, it is sufficiently impressive to make me hope that Aculab can overcome its tape difficulties. Once this happens, I can recommend the system to anyone who needs what really does amount to a slow-speed disc system. Meanwhile, however, you would be wise to wait.



An internal view of the unit revealing the extremely simple electronics. If the units could be made in this country rather than in the US we might well see a dramatic fall in cost.

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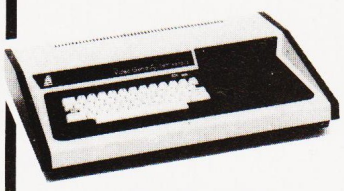

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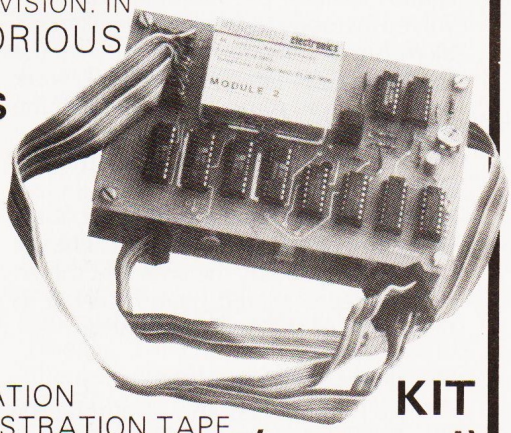

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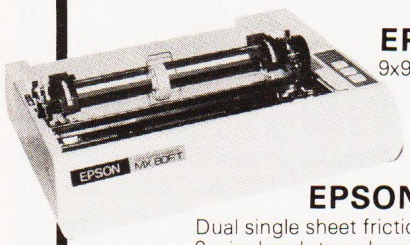

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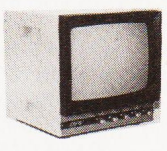

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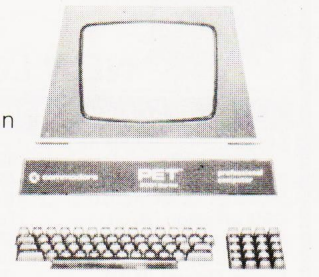

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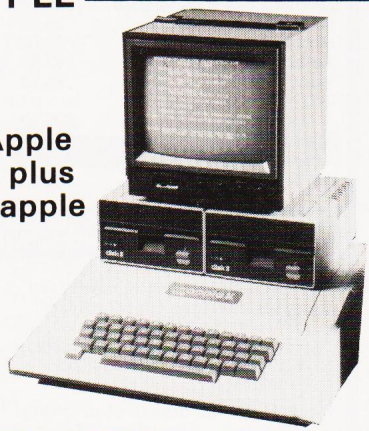

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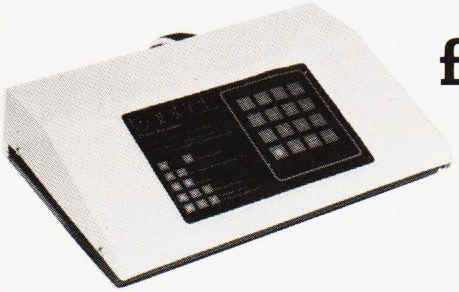

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BOOK PAGE

A new feature where we regularly review some of the latest publications on the market.

Books published by Bernard Babani played a large part in my early interest in electronics. Wandering around electronics shops in Edgware Road, I usually came away with some slim pamphlet of circuits. The two big attractions were low cost and the practical nature of the contents. Later, the Babani list of titles suffered, in my opinion, by being out of date — probably as a result of the electronics shops selling few of them and thus being swamped with old stock. My view was changed for the better recently, when examining the shelves in one of my favourite bookshops I came across a whole section of brightly-coloured paperbacks bearing the Babani banner. Most of the set were reasonably priced, well-presented and seemed relevant to modern electronics.

The Babani range of titles still have an essentially practical nature, a fact that is well-demonstrated in the slim volume **Beginner's Guide to Digital Techniques.** In this book, G T Rubaroe sets out to impart a clear understanding of digital techniques so that his readers can make "maximum use of the wide range of digital devices available today". This is a book aimed at the absolute beginner. In the introductory chapter the differences between an analogue and a digital signal are briefly explained, and chapter 5 is devoted to conversions from one to the other and vice versa. Chapters 2 and 3 deal with number systems and codes in an easily assimilated manner and chapter 4 is a useful exposition of logic functions. In chapter 6 the author takes a "brief look at a few important applications of digital techniques". The examples chosen are the digital computer, the digital voltmeter and the digital frequency meter. Brevity certainly is the keynote of this chapter, but at least by this stage the reader has sufficient basic knowledge to be able to progress to more advanced texts. A feature of this book and of almost all Babani titles, is the helpful inclusion of diagrams and tables. This title, however, includes no constructional projects. The traditional approach of this book is for the person who knows nothing about electronics nor computers but who wants to acquire basic knowledge quickly and painlessly.

The **Beginner's Guide to Microprocessors and Computing,** by E F Scott, is the first venture into computing that the Babani series has made. The book claims that "the only prior knowledge which has been assumed is basic arithmetic and an understanding of indices, so the book should therefore prove useful for pupils preparing for CSE and O Level examinations as well as to technicians, engineers and hobbyists". I agree with this statement, and would add that this is more of a 'study' book than one of general interest. The first section covers the theory and practice of binary arithmetic. It is clear and well-written. Just how relevant binary arithmetic is to modern microprocessors is debatable, but if you do feel you need to know about it then this chapter will do. My biggest criticism is that it is dealt with in chapter 1. Why start a book with perhaps one of the most boring and theoretical of topics? Chapter 2 gives a conventional and straightforward explanation of the parts and workings of a microprocessor/computer. Again, the inclusion of clear diagrams enhances the text. The third and final chapter is entitled "Programming" and is notable for its brevity. In ten pages it covers machine code for the 8080 (with examples), high-level languages, VDUs, interrupts, handshaking, and more. This gives no more than a glimpse of any one topic. A useful glossary is included along with an appendix describing 8080 instructions. Exercises are presented together with sample solutions. This is not an inspiring book — if you are not already interested in micros then don't start here — but if you've an exam to pass then it is worth consideration as it is cheap, well-written and reasonably produced.

The final two titles I have selected for this review are both by E A Parr and are both aimed at the relative newcomer to electronics and computing. **A Microprocessor Primer** is intended as a basic guide and provides a traditional introduction to computers and their underlying concepts. My main criticism of it is its chosen approach, that of designing yet another simple computer (as if there were not enough existing ones) and basing the design on a machine of the early 1960s. In the latter part of the book a real, contemporary CPU, the Z80, is introduced and it is only at that point that this book becomes relevant and interesting. Unfortunately, after a few pages Mr Parr's account ends — but there is a useful glossary which is some compensation. **Practical Computer Experiments** is intended, according to the author, "to fill in some of the background to the microprocessor by constructing typical computer circuits in discrete logic". Readers are recommended to construct the circuits described for themselves and the book has not much to offer you unless you are prepared to take this advice. As little information is given about circuit layout, this is not a book for the novice in electronics. If, however, you have some experience of other circuits and want to discover how computers work then you should find Mr Parr's suggestions interesting and informative. On the whole, both Mr Parr's books approach microprocessors tentatively rather than get really stuck in.

After my recent reawakening to their existence, I have discovered that the Babani range of paperbacks is to be found in a surprisingly wide variety of outlets including electronics shops. Look out for the Babani stand with its colourful paperback volumes. In these dismal days of inflation they remain cheap and well worth a second look.

The titles reviewed in this article were:

BP 61 BEGINNER'S GUIDE TO DIGITAL TECHNIQUES by G T Rubaroe (1979) 95p
BP 66 BEGINNER'S GUIDE TO MICROPROCESSORS AND COMPUTING by E F Scott (1980) £1.75
BP 72 A MICROPROCESSOR PRIMER by E A Parr (1980) £1.75
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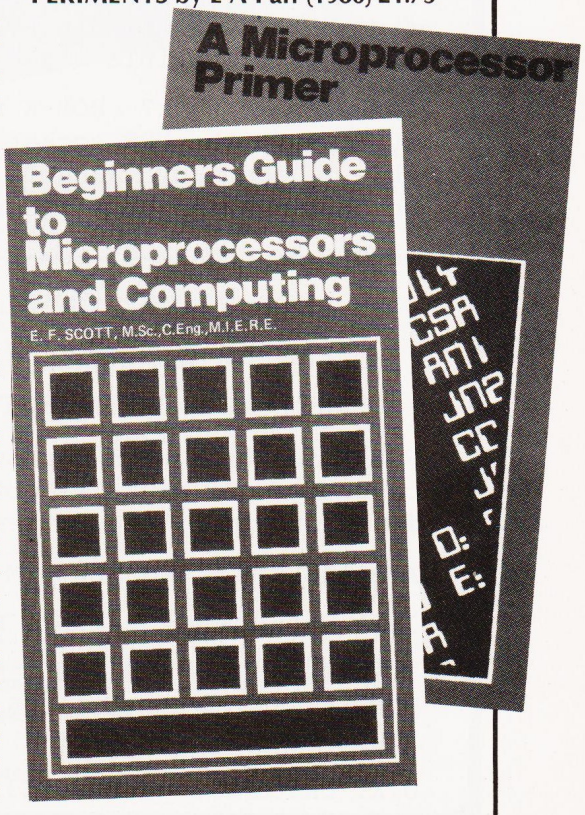

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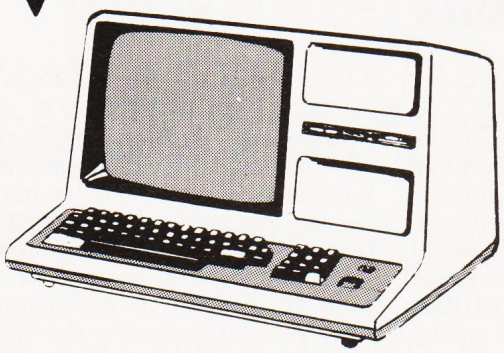

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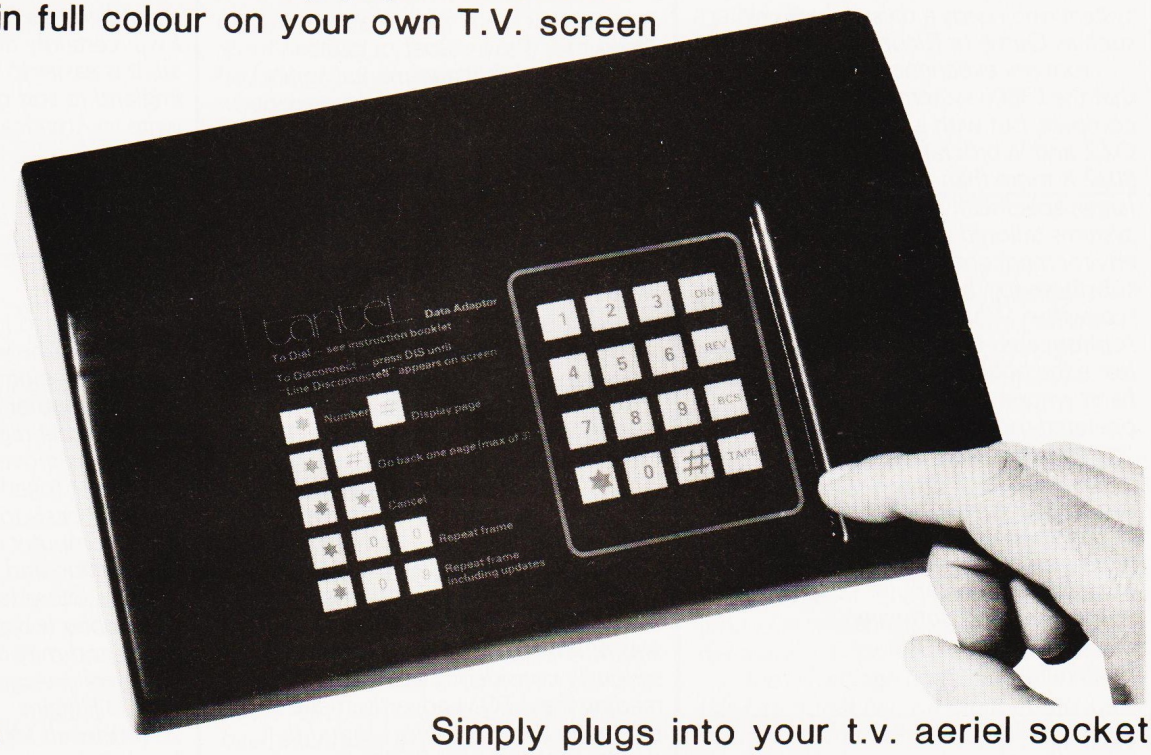

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Dear Sir,
As the owner of a CMB 8032 system, I endorse what your correspondent has said in his review. I would, however, suggest that he has underplayed his hand and that the system is far more versatile than the report suggests.

As well as OZZ, there is the Wordcraft 80 software which provides a word-processing capability which is more than enough for the majority of small business applications. My own particular interest is in the production of camera-ready copy for reprints of conference papers. In contrast to the Commodore handbooks, Wordcraft 80 comes with a copious file of operating instructions and examples, which are easy for the uninitiated to follow. However, to get the best from the system one needs a daisy wheel printer such as Qume or Ricoh.

From my experience, I would say that the £3000 system cannot really compete, but with a different printer, OZZ and Wordcraft 80, at £4500 the 8032 is more than a match for many larger, specifically word-processing systems tailored to the office environment and promoted as a substitute for the traditional electric typewriter. Why give the secretary a sophisticated electronic gadget and leave the book keeper sweating over hand written ledgers and a lever-operated mechanical calculator?

I feel that it would be very revealing if you were to make a comparative survey of the utilisation patterns within offices that have the large dedicated word-processors, and those that have gone for microcomputer systems with word-processing software.
Eric Jeffs
Buckinghamshire

Dear Sir,
How about this three line wonder for the NASCOM 2 for converting Decimal numbers to their Hex equivalents (very useful when PEEKing and POKEing)

```
10 DOKE2048,1578:DOKE2050,
   -15608:DOKE2052,768
20 DOKE4100,2048:INPUT
   "DECIMAL";A:DOKE2054,A
30 X=USR(X):PRINT"HEX":GOTO 10
```

Phil Green
Sheffield

Dear Sir,
Mr McCartney's excellent article (March 1981) on Boolean algebra is a timely reminder of a facility in BASIC which is not sufficiently exploited by home programmers.

His article, however, is based on his concern for saving program lines and illustrated by the example of flipping a variable between 0 and 1. He could also save execution time, by the statement LET F=1−F which, if F is initially set to 0, will then flip between 0 and 1. I think he would agree that it is also clearer to other users — but his article was on Booleans, of course.

In general, the statement LET V=(a+b)−V will flip between a and b, if V is initially set to either a or b. This can be handy for flashing characters in a memory-mapped display. To flash the letter A alternately with a space, first set V=65(ASCII for A), then flip by LET V=97−A and display by POKE SC,V at suitable intervals.
Gwyneth Pettit
W Yorks

Dear Sirs,
Thanks for 'Power Boat', a game requiring real skill and mental agility.

After quite a few manhours over a hot keyboard, I finally managed to complete the course, and another player actually took the lead once!

This was, however, only after we discovered that some saboteur was deliberately crossing the rudder wires! How many boats we wrecked, you wouldn't believe, before re-writing:-

```
1030 IF C<0 THEN 1060
```

Now maybe we can concentrate on driving without crossing hands!
Harold Watson
Cleethorpes

Dear Sir,
After reading Mr Sinclair's article about the ACORN ATOM, in the April issue, I was much impressed by it and I am seriously considering buying one. Upon reading the ATOM advertisement, printed in the magazine, I found that the 8K ROM and 2K ROM version could be extended with 1K RAM chips. Could you please tell me how many of these chips can be added to produce a maximum of RAM?
O Gold
Cheltenham

(***The ATOM can be expanded to give a total of 6K of graphics space, extra addresses between 8400H and 9800H. The user memory can also be expanded to a total of 6K, the extra addresses start at 2800H. Ed***)

Dear Sirs,
I write a word of warning to your readers, concerning the ordering of magazines directly from the USA, hoping to save a little money.

In April 1980, I sent a subscription to a very well known, and well written, American computing magazine, paying by Barclaycard. In June 1980, I was duly billed, and then I sat and waited for the normal "allow eight weeks for processing" to pass.

Having received no magazines for about five months, I wrote to the magazine's subscription department, asking for an explanation.

No explanation came, but a magazine did in December. However, I haven't had any since.

I have now just written another letter to both the subscription and the editorial offices of the magazine, hoping I might get a reply and a further 11 issues of the magazine.

The moral is not that we should not buy these magazines at all, but that we should go to a British distributor. I know I will certainly do that next time. After all, it is easier to phone a distributor in England to sort out a problem, than to write to America and only hope for a reply.
Paul Blitz
Southampton

Dear Sir,
I would like to inform those readers of your magazine who live in the West Yorkshire region that the Leeds Microcomputer Users Group which used to meet regularly in Telecom House has moved to a new venue.

We get together fortnightly on an informal basis to exchange microcomputer news, technical information and programming hints. Anyone interested in microcomputing as a hobby is welcome to join this group and may do so by contacting me at the following address:-
Paul O'Higgins
20 Brudenell Mt,
Leeds 6
Yorkshire

Dear Sir,
I am writing to ask you if it would be possible for you to include the following information concerning a new computer club which has just started in Bedford.

The address of the secretary is:-
Mr R. Bird
The Secretary
Bedford Amateur Computer Club
7A High Street
Great Barford
BEDFORD
MK44 3LB
Tel:0234-870763

Thank you for your assistance.
Rowan Bird
Bedford

Dear Sirs,
May I point out an error in the "Snakes" program from the recent softspot special (April 1981), and add my high score system for the program.
Error in 120, the final POKE statement in this line should be:-

```
120. . . . :POKE I + 416,3 : NEXT I
```

Delete 135 and put this line at 68.

```
68   DIM P(100)
```

1620 should read;

```
1620 GOTO 255
```

If you want to re-choose your rating then 1530 should read:-

```
IF A$ = "Y" THEN 70
```

The high score addition is as follows;

```
300  Q=48
312  IF R5<Q THEN R5=Q
314  IF R5>57 THEN R5=Q
316  IF R4<Q THEN R4=Q
318  IF R4>57 THEN R4=Q
320  IF R3<Q THEN R3=Q
322  IF R3>57 THEN R3=Q
324  IF R2<Q THEN R2=Q
326  IF R2>57 THEN R2=Q
328  POKE 527,R5:POKE 528,R4:
     POKE 529,R3:POKE 530,R2
     (change this line:620 IF L=0 THEN 982)
982  P5=S5-48:P4=S4-48:P3=S3-48:
     P2=S2-48
984  PS=(P5*1000)+(P4*100)+
     (P3*10)+P2
986  IF PS<HS THEN 1000
988  HS=(P5*1000)+(P4*100)+
     (P3*10)+P2
990  R5=P5+Q:R4=P4+Q:R3=P3+
     Q:R2=P2+Q
```

M L Carrington
Stockport

Dear Sir,
I am writing in the hope that you may be able to offer some advice on a conversion of a ZX80 or 81, or could put me in touch with someone that could.

My idea at present is to try and fit, attach rather, a set of standard keys instead of the touch-sensitive ones that come on the ZX80. The reason for this is that I find that one has to make very sure of hitting the right part of the key to make sure of proper contact and I find this rather a bind since I am used to typing in general. Would this kind of conversion be possible with another make of keys and if so could you suggest any problems it might pose, or type of keyboard that would make possible this conversion?

I thank you for your trouble and look forward to hearing from you.
M Q Harrison
London

(*It should, in theory, be possible to replace the touch keyboard with a conventional type — Sinclair offered to do this in his BBC variant. You will have to trace out the matrix used, the PCB layout in other words, and build a new keyboard to this pattern. You *cannot* **use a conventional ASCII keyboard because the keys are not encoded to this format inside the ZX80. Ed*)**

Dear Sir,
I found the article 'using the NASCOM 2' in your March issue very useful and informative. The only thing that spoilt WS Lounds contribution, was an error in the BASIC program listing that accompanied the article, ie line 4130 should have read:-

```
4130 DATA 13872,9048, – 1264, – 4151,
     – 3056,2054
```

and **not** *as printed.*

This error caused a wrong byte in the machine code routine for USR(112) 'Routine (Set Up Screen Start)': which had the effect of resetting the NASCOM when executed. Location 0D10 was set to LD SP,HL (F9) rather than Return (C9). I hope this is of some help to any 'Nascomaniac' who had not already spotted the bug.
David J Woolnough
Suffolk

Dear Sir,
Could you clarify the following point concerning the 8K ROM for the ZX80?

The original version of this, without the ability to drive a printer, had 37 extra functions including DATA. This original 8K ROM was withdrawn in October 1980 and the ability to drive a printer added. The new 8K ROM now available is said to have all the functions of the ZX81 except for the moving graphics. So here is the crunch. The ZX81 does not have DATA so have some functions on the new 8K ROM been sacrificed in favour of the printer drive and its controlling commands?
A Colley
Wolverhampton

(*The new 8K BASIC is not equipped with READ or DATA but you can get over this by a method quoted on pages 145/6 of the new manual. Because you can save program variables at the same time as the program with both the ZX80 and 81 Sinclair reckons that the loss of these two functions is not too significant. Ed*)

Dear Sirs,
I would be obliged if you would change the relevant information in the list of microcomputer user clubs which you maintain.

The Chelmsford TRS-80 user group, has now moved and interested people can obtain details of the dates and locations of meetings from myself at my address and telephone number below. (Meetings are still in the Chelmsford area.)

I am also pleased to announce the formation of a new microcomputer group:-

The North East London
'80' users group,
2 Priory Avenue,
Walthamstow,
London E17.

This group is aimed at users of systems based on any '80' microprocessor (ie 8008, 8080, 8085, Z80). People interested in joining should contact me at the same address as for the Chelmsford group.
R J Hamlett,
Pine Lodge,
Debden Road,
Loughton,
Essex IG10 2NY.
Tel: 01-508 0062

Dear Sir,
Whilst the Acorn ATOM is not provided with an INKEY$ function, I have found several addresses that are affected by key depression, not only #B001 as mentioned in the manual. However all the addresses that I've found are affected by the same few keys, namely control, shift, 3, minus, Q and G. The first four keys are conveniently placed for two people to control two screen events individually, say two bats moving either up or down. But apart from "G to go" the keys are limited mnemonically. There's no "D to detonate", "F for fire" or "W for warp"!

One advantage I have found over INKEY$ is that two different events can take place simultaneously. For example, two bats moving up, or one up and the other down or both down or only one moving at a time. This is because the pressing of two keys at once causes the address to change to a value that is different from that which is obtained from pressing either key separately. For example #B001 is affected as follows: Control gives 191, Shift gives 127 and both together give 63. The INKEY$ (on the Vector Graphic at least) will only register one key at a time so for Tennis, one player must stop pressing before the other can move the bat.

If any ATOM users have found addresses that are affected by other keys or who have a subroutine approaching INKEY$, don't keep it to yourselves, write in to CT . . . I can't live without my "W for warp"!
J N Rolinson
Nottingham

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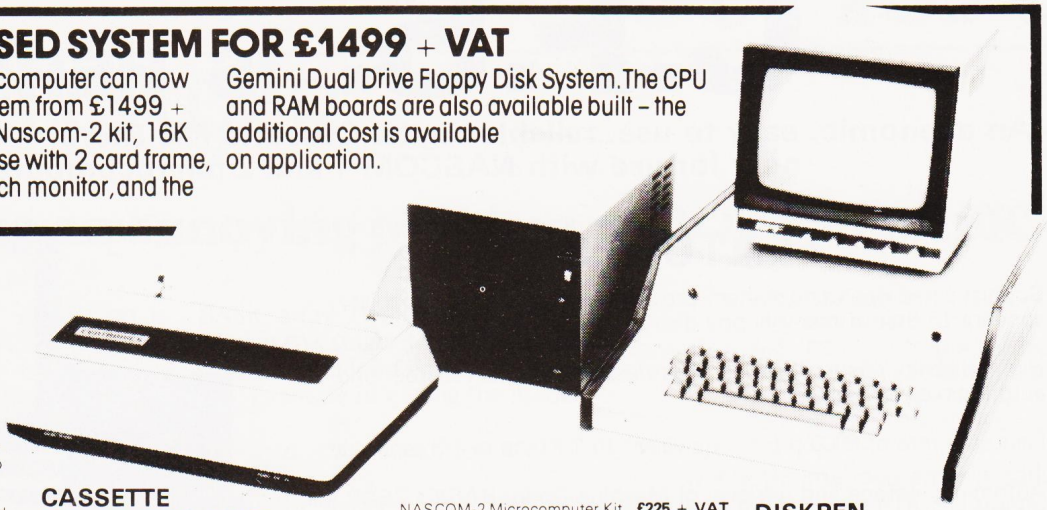

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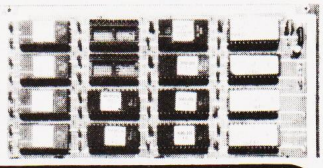

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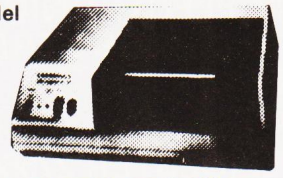

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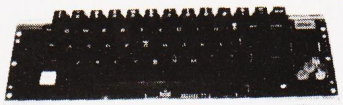

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ARRAY LOADER

Andrew F Lack

A solution to an annoying problem with Triton BASIC

This machine code subroutine is called from a BASIC program whenever an array is required to be loaded from cassette. The loader performs the following steps:

1. switch on cassette power
2. print start message
3. print any file names
4. search for the *first* BASIC string array
5. load it into a buffer
6. switch off power when finished
7. return to BASIC with either an error flag or array's dimension.

Once loaded a BASIC routine is used to map the array from the buffer (which is outside BASIC's workspace) into a real BASIC array. The returned dimension is used at this stage; if zero is returned this means that a load error was detected.

Example of calling the loader:

```
100  CALL $5800,1,DM
```

where the loader starts at 5800H and the dimension is returned in the variable DM (the value '1' is a dummy argument in this case).

Example of mapping an array into BASIC:

```
110  IF DM=0 THEN PRINT "ERROR
     IN LOADING":STOP
120  DIM A$(DM)
130  PTR=$5891
140  FOR I=0 TO DM:L=PEEK (PTR)
150  FOR J=1 TO L:A$(I)=A$(I)+
     CHR$(PEEK(PTR+J))
160  NEXT:PTR=PTR+L+1:NEXT
```

where the mapped array is called A$( ) and the variable PTR is a pointer to the start of the buffer.

It is suggested that the end address of L7.2 should be set about 2K below the end address of memory. Since the loader takes about 130 (decimal) bytes then that leaves over 1.75K of buffer for the array. Note that this loader *does not* check for buffer overflow!

Program Listing

```
0000                        ORG 5800H
                OUTCH       EQU 0013H       ;PRINT CHAR TO VDU
                PSTRNG      EQU 002BH       ;PRINT STRING -> DE
                PCRLF       EQU 0033H       ;PRINT NEWLINE ON VDU
                TAPOF       EQU 004AH       ;SWITCH CASSETTE OFF
                URTER       EQU 0365H       ;FETCH CHAR CHECK FOR
                                             ERROR
                TAPON       EQU 03F6H       ;SWITCH CASSETTE ON
                URTIN       EQU 0E62H       ;FETCH CHAR FROM UART
5800 11 72 58   START:      LXI D,LDMES     ;START MESSAGE
5803 CD2B 00                CALL PSTRNG     ;PRINT
5806 CDF6 03                CALL TAPON      ;SWITCH ON CASSETTE
5809 CD33 00    PCOUNT:     CALL PCRLF      ;PRINT NEWLINE
580C 06 40                  MVI B,40H       ;READY FOR SYNC COUNT
580E CD62 0E    LOOKHD:     CALL URTIN      ;LOAD CHAR
5811 FE 0D                  CPI 0DH         ;SYNCH CHAR?
5813 C2 0C 58               JNZ PCOUNT+3    ;NO-CONTINUE TO LOOK
5816 05                     DCR B           ;YES-COUNT THEM
5817 C2 0E 58               JNZ LOOKHD      ;IF MORE THEN LOOP BACK
581A CD62 0E                CALL URTIN      ;READ NEXT CHAR
581D A7                     ANA A           ;CHECK ZERO (BASIC FILE)
581E C2 0C 58               JNZ PCOUNT+3    ;IF NOT THEN REJECT LOAD
5821 CD62 0E                CALL URTIN      ;READ HEADER NAME
                                             LENGTH
5824 57                     MOV D,A         ;SAVE IN D
5825 0E 3F                  MVI C,3FH       ;'?'READY FOR ANY ERRORS
5827 21 91 58               LXI H,DATASA    ;START ADDRESS OF
                                             BUFFER
582A CD65 03    RDHDR:      CALL URTER      ;READ FIRST (NEXT) NAME
                                             CHAR
582D CD13 00                CALL OUTCH      ;PRINT CHAR
5830 15                     DCR D           ;FINISHED WITH NAME?
5831 C2 2A 58               JNZ RDHDR       ;JUMP IF NO
5834 CD65 03                CALL URTER      ;READ FILE TYPE BYTE
5837 FE 81                  CPI 81H         ;STRING ARRAY?
5839 C2 09 58               JNZ PCOUNT      ;REJECT LOAD IF NOT
583C CD65 03                CALL URTER      ;READ DIMENSION (LOW)
853F 5F                     MOV E,A         ;SAVE IN E
5840 CD65 03                CALL URTER      ;READ DIMENSION (HIGH)
5843 06 02                  MVI B,02H       ;FOR LOOP CONTROL
5845 A7         DIVBY2:     ANA A           ;CLEAR CARRY FLAG
5846 7A                     MOV A,D         ;HIGH BYTE TO A
5847 1F                     RAR             ;SHIFT LSB INTO CARRY
5848 57                     MOV D,A         ;RESTORE TO D
5849 7B                     MOV A,E         ;LOW BYTE TO A
584A 1F                     RAR             ;CARRY TO HIGH BIT
584B 57                     MOV E,A         ;RESAVE
584C 05                     DCR B           ;FINISHED SHIFTING?
584D C2 45 58               JNZ DIVBY2      ;JUMP IF NO
5850 D5                     PUSH D          ;SAVE DIMENSION ON
                                             STACK
5851 D5         LGSTGL:     PUSH D          ;AND SAVE AGAIN
5852 CD65 03                CALL URTER      ;GET FIRST (NEXT) STRING
                                             LENGTH
5855 5F                     MOV E,A         ;SAVE IN E
5856 77                     MOV M,A         ;SAVE IN BUFFER
5857 23                     INX H           ;BUMP POINTER
5858 CD65 03    LDSTNG:     CALL URTER      ;GET STRING CHAR
585B 77                     MOV M,A         ;STORE IN BUFFER
585C 23                     INX H           ;INCREMENT POINTER
585D 1D                     DCR E           ;FINISHED THIS STRING?
585E C2 58 58               JNZ LDSTNG      ;JUMP AND REPEAT IF NO
5861 D1                     POP D           ;GET DIMENSION FROM
                                             STACK
5862 1B                     DCX D           ;DECREMENT DIMENSION
5863 7A                     MOV A,D         ;CHECK IF DIMENSION
5864 A7                     ANA A           ;IS ZERO YET
5865 F2 51 58               JP LDSTGL       ;IF POSITIVE OR ZERO -
                                             REPEAT
5868 CD4A 00                CALL TAPOFF     ;IF FINISHED SWITCH OF
                                             TAPE
586B 79                     MOV A,C         ;SEE IF ANY ERRORS
                                             OCCURRED
586C A7                     ANA A           ;IF ZERO THEN ERROR(S)
586D D1                     POP D           ;GET DIMENSION FROM
                                             STACK
586E C0                     RNZ             ;IF NO ERRORS THEN
                                             RETURN
586F 57                     MOV D,A         ;CLEAR D REGISTER
5870 5F                     MOV E,A         ;CLEAR E REGISTER
5871 C9                     RET             ;AND RETURN TO BASIC
5872 44 41 54 41 LDMES:     DB 'DATA BEING LOADED-PLEASE WAIT',04H
     20 42 49 4E
     47 20 4C 4F
     41 44 45 44
     2D 50 4C 45
     41 53 44 20
     57 41 49 54
     04
5891                DATASA: DS 0            ;BUFFER AREA START
```

The subroutine should be saved using BASIC:

```
READY
>SAVE ("LOADER") $5800,$5891
```

Using this technique the loader may be recovered from cassette by a BASIC program which is going to use it before it is required.

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The principles, concepts and applications of an 8-bit microcomputer based on the 8080 microprocessor CPU chip. The emphasis is on a computer as a controller.

Scelbi— 6800 SOFTWARE GOURMET GUIDE AND COOKBOOK £9.20

Scelbi— 8080 SOFTWARE GOURMET GUIDE AND COOKBOOK £9.20

Haviland— HOW TO DESIGN, BUILD AND PROGRAM YOUR OWN WORKING COMPUTER SYSTEM. £7.10

Spencer— GAME PLAYING WITH BASIC £5.95

Schoman, K.— THE BASIC WORKBOOK £4.10

Sirion, D.— BASIC FROM THE GROUND UP £6.20

Soucek, B.— MICROPROCESSORS AND MICROCOMPUTERS £19.40
Here is a description of the applications programming and interfacing techniques common to all microprocessors.

Spracklen, D.— SARGON £10.00
A computer chess program in Z-80 assembly language.

Titus— MICROCOMPUTER ANALOGUE CONVERTER £7.60

Titus— 8080/8085 SOFTWARE DESIGN £7.60

Tracton— 57 PRACTICAL PROGRAMS & GAMES IN BASIC £6.65
Programs for everything from Space war games to Blackjack.

Waite, M.—MICROCOMPUTER PRIMER £8.95

Waite, M.— YOUR OWN COMPUTER £2.25
Introduces the beginner to the basic principles of the microcomputer.

Libes, S.— SMALL COMPUTER SYSTEMS HANDBOOK £6.20
The Primer written for those new to the field of personal home computers.

Lippiatt— ARCHITECTURE OF SMALL COMPUTER SYSTEMS £6.10

Moody, R.— FIRST BOOK OF MICROCOMPUTERS (the home computer owner's best friend) **£4.00**

McGlynn, D.R.— MICROPROCESSORS — Technology, Architecture & Applications £11.30
This introduction to the computer-on-a-chip provides a clear explanation of the important new device.

Hordeski— MICROPROCESSOR COOKBOOK £4.95

Monro— INTERACTIVE COMPUTING WITH BASIC £4.35

Nagin, P.— BASIC WITH STYLE £4.50
Programming Proverbs. Principles of good programming with numerous examples to improve programming style and producing.

Ogdin— SOFTWARE DESIGN FOR MICROCOMPUTERS £9.25

Ogdin— MICROCOMPUTER DESIGN £7.45

Peatman— MICROCOMPUTER BASED DESIGN £6.10

Peckham— HANDS ON BASIC WITH PET £11.95

Peckham— BASIC — A HANDS ON METHOD £10.25

Sawusch— 1,001 THINGS TO DO WITH YOUR PERSONAL COMPUTER £6.00

Coan, J.S.— BASIC BASIC £7.25
An introduction to computer programming in BASIC language.

Ditlea— A SIMPLE GUIDE TO HOME COMPUTERS £4.10

Gilmore, C.M.— BEGINNERS GUIDE TO MICROPROCESSORS £4.90

Safford— COMPLETE MICROCOMPUTER SYSTEMS HANDBOOK £8.75

Graham, N.— MICROPROCESSOR PROGRAMMING FOR COMPUTER HOBBYISTS £7.15

Hordeski— ILLUSTRATED DICTIONARY OF MICROCOMPUTER TECHNOLOGY £6.95

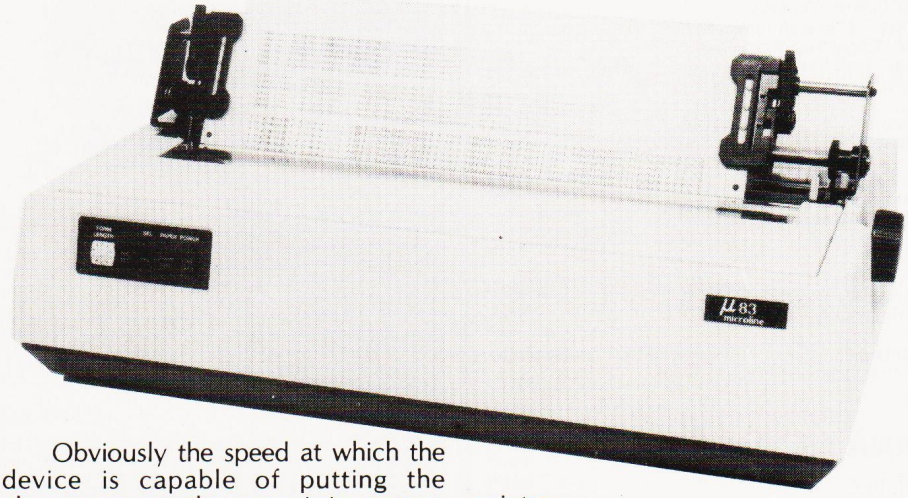
Heiserman, D.L.— MINIPROCESSORS FROM CALCULATORS TO COMPUTERS £5.35

Ward— MICROPROCESSOR/MICROPROGRAMMING HANDBOOK £6.00
Authorative practical guide to microprocessor construction programming and applications.

Goodman— TROUBLESHOOTING MICROPROCESSORS AND DIGITAL LOGIC £5.90

Zaks, R.— MICROPROCESSORS FROM CHIPS TO SYSTEMS £8.50

Printers are the subject of this month's new style survey.



The choice of low-cost printers for the microcomputer user has expanded rapidly over the last few years with the introduction of new technology. Prices have also come tumbling down as the market has expanded, so that selecting a device is an even harder task — hence the inclusion of a regular Buyer's Guide in the magazine.

The following pages list all the suitable printers that we know about which are available on the UK market, and the purpose of this introduction is to help the potential purchaser get the best out of the information presented.

As far as we can we have listed the major UK source of supply of each device or family of devices, whether a distributor or the actual manufacturer, and it is to this address that you should write if you have any enquiries or problems locating a local source of supply.

Heading It Up

There are several ways of getting a character onto a piece of paper but these can be classified into two major categories, impact and non-impact. The former category includes 'dot-matrix', 'daisywheel' and 'golfball' types whereas the latter include 'electrostatic' and 'thermal' types. The relevant entry in the product list is **Face**. A matrix printer, whether impact or not, creates its characters by using a set of needles. The number used to create each character is given under the **Head size** entry. Basically, a 5 by 7 head will not be able to produce as good a character as a 9 by 7 head: the former type cannot produce descenders on letters such as 'p', 'q' and 'g'. Thermal and electrostatic printers require special paper rather than using a conventional typewriter ribbon to create the image on normal paper. Daisy and golfball type printers produce a much higher quality type in a manner similar to that used by a conventional typewriter. They are normally used for correspondence and tend to be much more expensive.

Connecting It Up

The **Interface** is the method of connection to your micro; serial, parallel, etc. Several printers are offered with custom interfaces for certain popular micros — check the **Options** entry further down the list for these. If a serial interface is available the speed at which the micro can send information is given in the **Baud rates** entry.

Obviously the speed at which the device is capable of putting the characters onto the paper is important, and this is shown in the **Print speed** entry (cps stands for characters per second). A note specifying 'bi-directional' against this entry means that the printing head is capable of printing backwards — you don't have to wait until the head has returned to the left-hand margin. Because of this a bi-directional 120cps printer will actually be able to print faster than a 120cps mono-directional device.

The way the printer handles the paper is shown in the **Paper feed** entry. Friction feed is similar to a normal typewriter, OK for single sheets but not so good for continuous stationery. Sprocket feed is basically the same as friction feed except that there are pegs mounted on the end of the platten which engage in the holes in continuous stationery and keep it straight. Tractor feed is the best of all if you are using continuous stationery. It can usually be adjusted for various widths of paper.

Colums Of Type

The **Columns** entry tells you how many 'normal'-sized characters can be printed on each line, a hang-over from the days of machines like the faithful Teletype. An entry under **Type sizes** tells you if the printer can produce different sizes of character; expanded and compressed are generally available on matrix printers.

Some printers offer **Graphics** characters as part of the normal font built into the machine, and others can be user-programmed with special characters or can produce 'High-res' dot graphics.

In general, the quoted **Price** is the end-user cost of the printer but, as prices change all the time, it is well worth shopping around for a bargain.

The Choice Of Options

The entries under **Options** and **Notes** detail any special extras available and any special qualities that the printer might have. If you are looking for a printer to go with a simple personal computer then you are probably not interested in a high quality correspondence type, conversely if you expect to put a large amount of paper through your machine then you must be prepared to pay for a device capable of coping with that kind of volume.

If you are considering a printer for your business then you might have thought of using multi-part stationery. If you have, it is essential to check that the device can cope with this type of load; a normal type will simply not stand up to the strain.

ADCOMP

ADCOMP X80 SP
Dist:- Roxburgh Printers,
22 Winchelsea Road,
Rye, East Sussex
07973-3777

Face:-	Dot
Interface:-	RS232/IEEE/Centronics/ /20mA
Feed:-	Sprocket/Tractor
Head Size:-	8x8
Baud Rates:-	50-9600
Print Speed:-	100cps (bi-directional)
Col:-	80/96
Type Sizes:-	—
Graphics Option:-	Yes
Price:-	£795 - £840

Notes:- Intelligent bi-directional feed printer plotter with a variety of fonts.

ANADEX

DP-1000
Dist:- Anadex Ltd
Dorna House, Guildford Road,
West End, Woking, Surrey
09905-6333

+ regional outlets

Face:-	Dot
Interface:-	RS232/20mA/Centronics
Feed:-	Friction
Head Size:-	5x7
Baud Rates:-	110-2400
Print Speed:-	50cps
Col:-	40
Type Sizes:-	2
Graphics Option:-	No
Price:-	£400

Options:- Choice of the 3 indicated interfaces
Notes:- 40 column version of DP-8000 with slightly reduced facilities.

DP-8000

Face:-	Dot
Interface:-	RS232/20mA/Centronics
Feed:-	Sprocket
Head Size:-	9x7
Baud Rates:-	110-9600
Print Speed:-	112cps bi-directional
Col:-	80
Type Sizes:-	2
Graphics Option:-	—
Price:-	£500

Options:- Large character buffer, other interfaces
Notes:- General purpose dot matrix machine.

DP-9500

Face:-	Dot
Interface:-	RS232/20mA/Centronics
Feed:-	Tractor
Head Size:-	9x9 or 9x7
Baud Rates:-	110-9600
Print Speed:-	200cps bi-directional
Col:-	132/220
Type Sizes:-	2
Graphics Option:-	Yes
Price:-	£895

Options:- Extended character buffer.
Notes:- 132 column system with expansion to 176 column with coms control. High density graphics.

DP-9501

Face:-	Dot
Interface:-	RS232/20mA/Centronics
Feed:-	Tractor
Head Size:-	9x11
Baud Rates:-	110-9600
Print Speed:-	200cps bi-directional
Col:-	—
Type Sizes:-	2
Graphics Option:-	Yes
Price:-	£995

Notes:- Extended carriage version of 9500 with higher density plotting.

ANDERSON JACOBSON

AJ 860
Manuf:- Anderson Jacobson
752 Deal Avenue, Slough,
Berkshire SL1 4SJ
Slough 25172

Also Manchester office

Face:-	Dot
Interface:-	RS232
Feed:-	Tractor
Head Size:-	9x5
Baud Rates:-	110-1200
Print Speed:-	120cps bi-directional
Col:-	132
Type Sizes:-	2
Graphics Option:-	Yes
Price:-	£—

Notes:- True descender matrix printer that gives both graphics and full APL character set.

AJ 832

Face:-	Daisy
Interface:-	RS232
Feed:-	Friction
Head Size:-	N/A
Baud Rates:-	110-300
Print Speed:-	30cps
Col:-	132/156
Type Sizes:-	Various
Graphics Option:-	Yes
Price:-	£2,560

Options:- Tractor option, 45cps printing option.
Notes:- Daisy wheel printer capable of both graphics plotting and APL printing. IBM 2741 compatible option.

AJ 880

Face:-	Dot
Interface:-	RS232
Feed:-	Friction
Head Size:-	7x9
Baud Rates:-	110-9600
Print Speed:-	30cps
Col:-	132/216
Type Sizes:-	—
Graphics Option:-	—
Price:-	£899

Options:- Tractor feed.
Notes:- Low cost APL terminal.

BASE 2

Z-800
Dist:- Zero One Electronics
36 Oaklands Avenue,
Thornton Heath, Surrey CR4 7PH
01-689 7924

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:-	£375

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

CENTRONICS

MICROPRINTER P1
Manuf:- Centronics Data Computer (UK) Ltd.,
Victoria Way, Burgess Hill, Sussex RH15 9NU
04446-56011

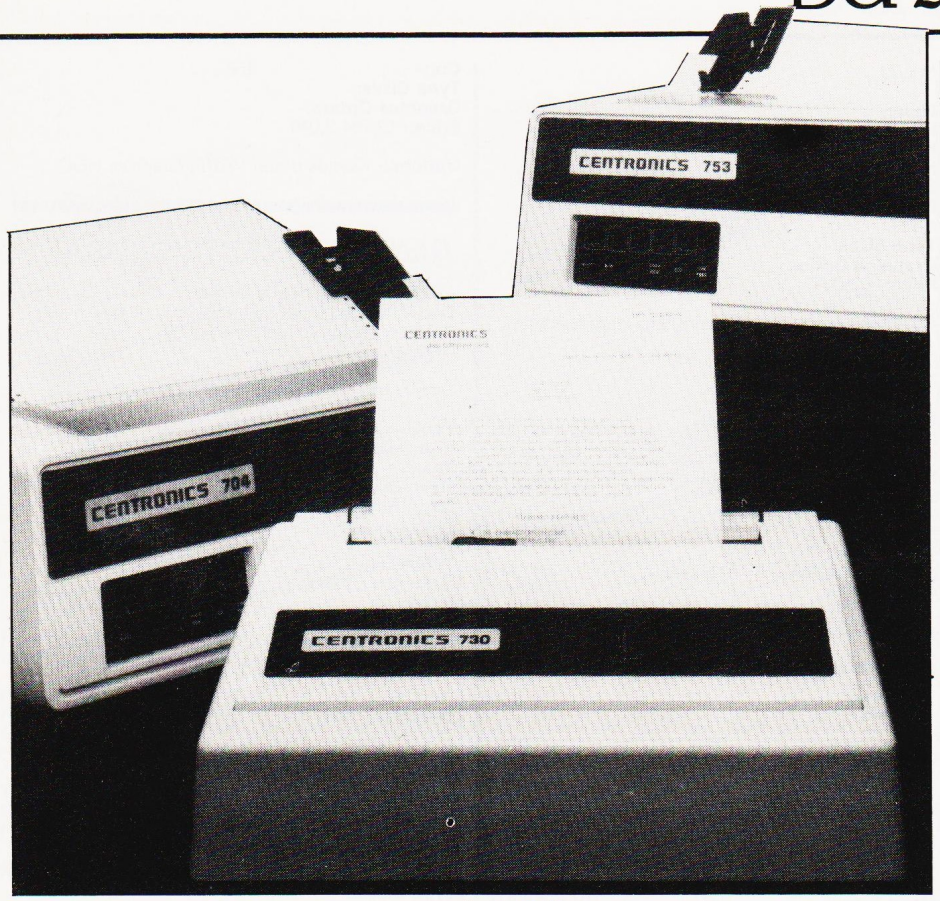
All prices are one-off OEM. Wide UK distribution network including Sintrom, Bytech, Datac, Hamilton Rentals, Rair, Comma, Dacoll and MIBF.

Face:-	Dot Electrostatic
Interface:-	Centronics
Feed:-	Friction
Head Size:-	5x8
Baud Rates:-	—
Print Speed	150 lpm
Col:-	132
Type Sizes:-	3
Graphics Option:-	—
Price:-	£190

Options:- Teletex/Prestel interface @ £375
Notes:- Software selectable line and type sizes.

MODEL 700

Face:-	Dot
Interface:-	Centronics



Feed:- Tractor
Head Size:- 5x7
Baud Rates:- –
Print Speed:- 60cps
Col:- 132
Type Sizes:- 2
Graphics Option:- –
Price:- £890

Notes:- Conventional low speed matrix printer.

MODEL 701

Face:- Dot
Interface:- Centronics
Feed:- Tractor
Head Size:- 5x7
Baud Rates:- –
Print Speed:- 60cps bi-directional
Col:- 132
Type Sizes:- 2
Graphics Option:- –
Price:- £980

MODEL 702

Face:- Dot
Interface:- Centronics
Feed:- Tractor
Head Size:- 7x7
Baud Rates:- –
Print Speed:- 120 cps
Col:- 132
Type Sizes:- 2
Graphics Option:- –
Price:- £1,210

Notes:- Faster version of 701 with extra form controls.

MODEL 703

Face:- Dot
Interface:- Centronics
Feed:- Tractor
Head Size:- 7x7
Baud Rates:- –
Print Speed:- 150cps
Col:- 132
Type Sizes:- 2
Graphics Option:- Yes
Price:- £1,360

Options:- Graphics plotting option.

MODEL 704

Face:- Dot
Interface:- RS232
Feed:- Tractor
Head Size:- choice
Baud Rates:- 110-9600
Print Speed:- 150cps bi-directional
Col:- 132
Type Sizes:- 2
Graphics Option:- –
Price:- £1,360

Options:- Stand, Buffer, "hush" kit.
Notes:- Large carriage high quality matrix printer.

730 MINIPRINTER

Face:- Dot
Interface:- Centronics
Feed:- Tractor/Friction
Head Size:- 7x7
Baud Rates:- –
Print Speed:- 100cps
Col:- 80
Type Sizes:- 2
Graphics Option:- –
Price:- £375
End user

Options:- Serial interface (730-4).

737 MINIPRINTER

Face:- Dot
Interface:- Centronics
Feed:- Tractor/Friction
Head Size:- Nx9 or 7x8
Baud Rates:- –
Print Speed:- 50 or 80cps
Col:- 80
Type Sizes:- 2
Graphics Option:- –
Price:- £425
End user

Options:- Serial interface version (737-4)
Notes:- Unit capable of proportional spacing and justification under micro control.

MODEL 753

Face:- Dot
Interface:- Centronics
Feed:- Tractor
Head Size:- Nx9
Baud Rates:- –
Print Speed:- 100-150cps bi-directional
Col:- 132
Type Sizes:- 2
Graphics Option:- –
Price:- £1,360

Options:- Stand, Various electronic options.
Notes:- Correspondence printer with proportional spacing.

MODEL 779

Face:- Dot
Interface:- Centronics
Feed:- Friction
Head Size:- 5x7
Baud Rates:- –
Print Speed:- 60cps
Col:- 80/132
Type Sizes:- 2
Graphics Option:- –
Price:- £370

Options:- Tractor feed.
Notes:- The original micro printer as supplied by Tandy.

MODEL 780

Face:- Dot
Interface:- Centronics
Feed:- Friction
Head Size:- 9x7
Baud Rates:- –
Print Speed:- 60cps
Col:- 80/132
Type Sizes:- 2
Graphics Option:- No
Price:- £830

Notes:- Upmarket version of 779 with better quality head.

MODEL 781

Face:- Dot
Interface:- Centronics
Feed:- Friction
Head Size:- 9x7
Baud Rates:- –
Print Speed:- 60cps
Col:- 80/132
Type Sizes:- 2
Graphics Option:- No
Price:- £930

Notes:- Bi-directional version of 780.

DATAROYAL

DATAROYAL IPS 5000
Dist:- Facit Data Products Ltd.
Maidstone Road, Rochester, Kent.
0634-401721

Face:- Dot
Interface:- RS232/Centronics
Feed:- Tractor
Head Size:- 9x9
Baud Rates:- 110-9600
Print Speed:- 125cps
Col:- 80/136
Type Sizes:- 2
Graphics Option:- –
Price:- £774 - 910

Options:- Large 136 column platten, 2K buffer, 20mA interface.
Notes:- Slightly less enhanced versions of FACIT 4525/6.

DIGITRONIX

DIGITRONIX MINI PRINTER
Manuf:- Digitronix Ltd,
10 Burners Lane, Kiln Farm Industrial Estate,
Milton Keynes.
0908-566888

Face:-	Electrostatic
Interface:-	RS232/20mA
Feed:-	Friction
Head Size:-	–
Baud Rates:-	110-4800
Print Speed:-	64cps
Col:-	32
Type Sizes:-	2
Graphics Option:-	Yes
Price:-	£195

Options:- Different font or graphics set
Notes:- Electrosensitive paper printer for data logging etc.

EPSON

EPSON TX 80
Dist:- Westrex,
Bilton Fairway Estate, Long Drive,
Greenford, Middx.
01-578 0957

Micro peripherals and others

Face:-	Dot
Interface:-	Centronics
Feed:-	Tractor/Friction
Head Size:-	5x7 or 6x7
Baud Rates:-	–
Print Speed:-	125cps
Col:-	–
Type Sizes:-	2
Graphics Option:-	Yes
Price:-	£395

Options:- Various micro interfaces including Pet, Apple, Tandy and Sharp
Notes:- PET graphics compatible printer.

MX 80-T

Face:-	Dot
Interface:-	Centronics
Feed:-	Sprocket
Head Size:-	9x9
Baud Rates:-	110-9600 (RS232)
Print Speed:-	80cps bi-directional
Col:-	80
Type Sizes:-	3
Graphics Option:-	Yes
Price:-	£360

Options:- As TX 80 plus RS232 and IEEE interfaces.

MX 80-FT

Face:-	Dot
Interface:-	Centronics
Feed:-	Friction/Tractor
Head Size:-	9x9
Baud Rates:-	110-9600 (RS232)
Print Speed:-	80cps bi-directional
Col:-	80
Type Sizes:-	3
Graphics Option:-	Yes
Price:-	£399

Options:- As MX 80-T.

MX 80-2

Face:-	Dot
Interface:-	Centronics
Feed:-	Friction/Tractor
Head Size:-	9x9
Baud Rates:-	110-9600 (RS232)
Print Speed:-	80cps bi-directional
Col:-	80
Type Sizes:-	3
Graphics Option:-	High res
Price:-	£420

Options:- As MX 80-T.

MX 70

Face:-	Dot
Interface:-	Centronics
Feed:-	Tractor
Head Size:-	5x7
Baud Rates:-	–
Print Speed:-	80cps
Col:-	80
Type Sizes:-	3
Graphics Option:-	High res
Price:-	£260

Options:- Apple, Tandy and Sharp interfaces only.

MX 100

Face:-	Dot
Interface:-	Centronics
Feed:-	Tractor
Head Size:-	9x9
Baud Rates:-	–
Print Speed:-	80cps bi-directional
Col:-	132
Type Sizes:-	3
Graphics Option:-	High res
Price:-	£TBA

Notes:- New model: check with distributor.

FACIT

FACIT 4520/1
Dist:- Facit Data Products
Maidstone Road, Rochester, Kent.
0634-401721

Face:-	Dot
Interface:-	RS232/Centronics
Feed:-	Friction
Head Size:-	9x7
Baud Rates:-	–
Print Speed:-	80cps
Col:-	80/132
Type Sizes:-	–
Graphics Option:-	–
Price:-	£583

Options:- Tractor feed (4521).
Notes:- Intelligent, bi-directional matrix printer.

FACIT 4525/6

Face:-	Dot
Interface:-	RS232 Centronics
Feed:-	Tractor
Head Size:-	9x9
Baud Rates:-	–
Print Speed:-	150cps
Col:-	80/132
Type Sizes:-	–
Graphics Option:-	–
Price:-	£890-1046

Options:- 132 column version (4526)
Notes:- Bi-directional printer, can be equipped with most European fonts.

FACIT 4530

Face:-	Dot
Interface:-	RS232/Centronics/20mA
Feed:-	Tractor
Head Size:-	5x7 or 9x7
Baud Rates:-	–
Print Speed:-	200cps
Col:-	132/198
Type Sizes:-	Various
Graphics Option:-	–
Price:-	£1,628

Notes:- Microcontrolled printer, capable of bar code printing.

FACIT 4540

Face:-	Dot
Interface:-	RS232/Parallel/ Centronics/IEEE/20mA
Feed:-	Tractor
Head Size:-	7x9 or 9x9
Baud Rates:-	–
Print Speed:-	250cps
Col:-	155
Type Sizes:-	–
Graphics Option:-	–
Price:-	£2,764-3,040

Options:- Keyboard unit (4610), Graphics (4542).

GENERAL ELECTRIC (USA)

TERMINET 200
Dist:- International General Electric of New York,
111 Park Road, London NW8 7JL
01-402 4100

Distributors include Zygal & Middlectron.

Face:-	Dot
Interface:-	RS232
Feed:-	Tractor
Head Size:-	7x9
Baud Rates:-	110-1200
Print Speed:-	200cps
Col:-	136/224
Type Sizes:-	–
Graphics Option:-	Yes
Price:-	

Notes:- Available as ASR, KSR or forms access printer with wide range of print formats.

TERMINET 2000

Face:-	Dot
Interface:-	RS232
Feed:-	Friction
Head Size:-	7x9
Baud Rates:-	–
Print Speed:-	–
Col:-	–
Type Sizes:-	–
Graphics Option:-	–
Price:-	

Options:- Tractor feed, character buffer, modem.
Notes:- KSR terminal unit offering three-part form handling and various print formats.

HEATH ELECTRONICS

H14
Dist:- Heath Electronics
Bristol Road, Gloucester GL2 6EE
0452-29451

+ London shop — 01-636 7349

Face:-	Dot
Interface:-	RS232/20mA
Feed:-	Tractor
Head Size:-	5x7
Baud Rates:-	110-4800
Print Speed:-	135cps
Col:-	80/132
Type Sizes:-	3
Graphics Option:-	–
Price:-	£413 (kit) — £592 (built)

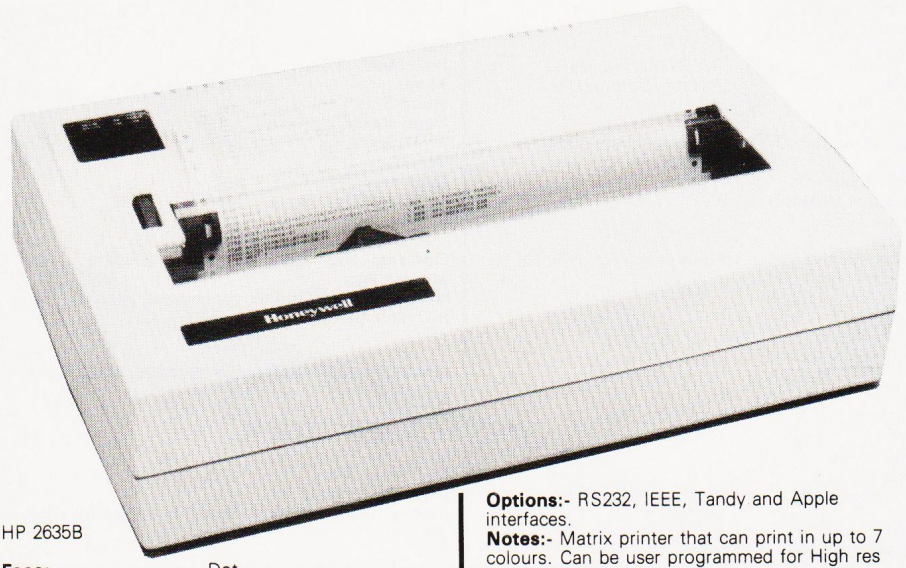
Notes:- High quality reliable printer with no frills.

HEWLETT PACKARD

HP 2631B
Dist:- Hewlett Packard Ltd.
308-314 Kings Road,
Reading, Berkshire RG1 4ES
0734-61022

Face:-	Dot
Interface:-	RS232/Centronics Centronics/IEEE
Feed:-	Tractor
Head Size:-	7x9
Baud Rates:-	110-2400
Print Speed:-	180cps
Col:-	132
Type Sizes:-	2
Graphics Option:-	–
Price:-	£2,110

Options:- Graphics copy option.
Notes:- Software selectable print densities and form sizes.



HP 2635B

Face:- Dot
Interface:- RS232/20mA Centronics/IEEE
Feed:- Tractor
Head Size:- 7x9
Baud Rates:- 110-2400
Print Speed:- 180cps
Col:- 132
Type Sizes:- 2
Graphics Option:- –
Price:- £2,315

Notes:- KSR version of 2631 with same facilities.

HONEYWELL

HONEYWELL S10
Dist:- MBS Terminals
Aldwych House, Madeira Road,
West Byfleet, Surrey KT14 6BA
09323-53151

Face:- Dot
Interface:- RS232
Feed:- Friction/Sprocket/Tractor
Head Size:- 7x7
Baud Rates:- –
Print Speed:- 80cps (bi-directional)
Col:- 80
Type Sizes:- –
Graphics Option:- –
Price:- £510

HONEYWELL S30

Face:- Dot
Interface:- RS232/Centronics
Feed:- Friction/Sprocket/Tractor
Head Size:- 7x7
Baud Rates:- –
Print Speed:- 80cps (bi-directional)
Col:- 132
Type Sizes:- –
Graphics Option:- –
Price:- £690

INTEGREX

CX 80
Manuf:- Integrex Ltd.,
Portwood Industrial Estate, Church Gresley,
Burton on Trent, Staffordshire DE11 9PT
0283-215432

Face:- Dot
Interface:- Centronics
Feed:- Tractor
Head Size:- 5x7
Baud Rates:- 300-9600 (RS232)
Print Speed:- 125-150 cps
Col:- 80
Type Sizes:- –
Graphics Option:- Yes
Price:- £895

Options:- RS232, IEEE, Tandy and Apple interfaces.
Notes:- Matrix printer that can print in up to 7 colours. Can be user programmed for High res graphics.

454C

Face:- Dot
Interface:- Parallel
Feed:- Tractor
Head Size:- 9xn
Baud Rates:- 300-9600 (RS232)
Print Speed:- 250cps bi-directional
Col:- 155
Type Sizes:- 2
Graphics Option:- Yes
Price:- £3,950

Options:- Centronics, RS232 and IEEE interfaces.
Notes:- High quality seven colour matrix printer – professional version of CX80.

LEAR SIEGLER

BALLISTIC 300
Dist:- Penny & Giles Recorders Ltd.
Mudeford, Christchurch,
Dorset BH23 4AT
04252-71511

Face:- Dot
Interface:- RS232/20mA
Feed:- Tractor
Head Size:- 9x7
Baud Rates:- 75-9600
Print Speed:- 180cps
Col:- 136
Type Sizes:- –
Graphics Option:- –
Price:- –

Options:- Foreign character sets, 9x9 or 9x12 heads.
Notes:- Micro controlled 'smart' printer with powerful forms control.

LOGABAX

LOGABAX 100
Dist:- Brospa Data
87 Castle Street, Reading,
Berkshire RG1 7ST
0734-589393

Face:- Dot
Interface:- RS232/Parallel/Centronics/IEEE/20mA
Feed:- Tractor
Head Size:- Various
Baud Rates:- 110-9600
Print Speed:- 100cps
Col:-
Type Sizes:- 2
Graphics Option:- No
Price:- £1,152

Options:- Stand and paper handling trays.

LOGABAX 200

Face:- Dot
Interface:- RS232/Parallel/Centronics/IEEE/20mA
Feed:- Tractor
Head Size:- 7x9 or 9x9
Baud Rates:- 110-9600
Print Speed:- 180cps
Col:-
Type Sizes:- 2
Graphics Option:- Yes
Price:- £1,590

Options:- Stand and paper handling trays.
Notes:- Bi-directional matrix printer with expanded and compressed type facility.

LOGABAX LXI200

Face:- Dot
Interface:- RS232/20mA/Centronics
Feed:- Friction/Sprocket/Tractor
Head Size:- 9xn
Baud Rates:- 110-9600
Print Speed:- 180cps (bi-directional)
Col:- –
Type Sizes:- Selectable (various)
Graphics Option:- Yes
Price:- £2,031

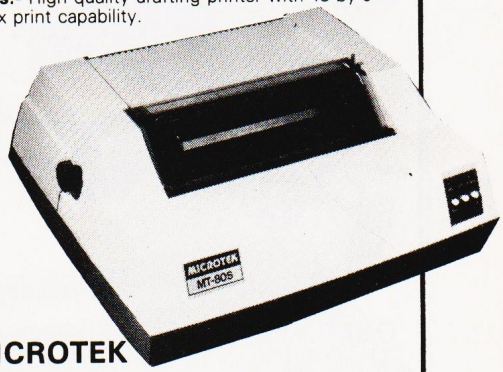
Options:- Stand and paper holder
Notes:- Full software controlled matrix printer offering WP quality and facilities.

MASTERPRINT

MASTERPRINT 165
Dist:- MBS Terminals,
Aldwych House, Madeira Road,
West Byfleet, Surrey KT14 6BA.
09323-53151

Face:- Dot
Interface:- RS232/Centronics
Feed:- Tractor
Head Size:- 10x9
Baud Rates:- –
Print Speed:- 90/165cps (bi-directional)
Col:- –
Type Sizes:- 2
Graphics Option:- Yes
Price:- £1,450

Options:- Apple and S100 interfaces, special character sets, high resolution graphics
Notes:- High quality drafting printer with 18 by 9 matrix print capability.



MICROTEK

MICROTEK MT 80P
Dist:- HAL Computers,
133 Woodham Lane, New Haw,
Weybridge, Surrey KT15 3NJ
Weybridge 48346

Face:- Dot
Interface:- RS232/IEEE/Centronics
Feed:- Tractor
Head Size:- 9x7
Baud Rates:- to 9600
Print Speed:- 125cps
Col:- 80/120
Type Sizes:- 2
Graphics Option:- No
Price:- £495 - £550

Options:- Various interfaces, character buffer.
Notes:- 80 or 120 column matrix printer.

NASCOM

IMP
Dist:- Currently available from many local outlets.

Face:-	Dot
Interface:-	RS232
Feed:-	Friction
Head Size:-	7x7
Baud Rates:-	110-9600
Print Speed:-	60 lpm
Col:-	80
Type Sizes:-	—
Graphics Option:-	Yes
Price:-	£325

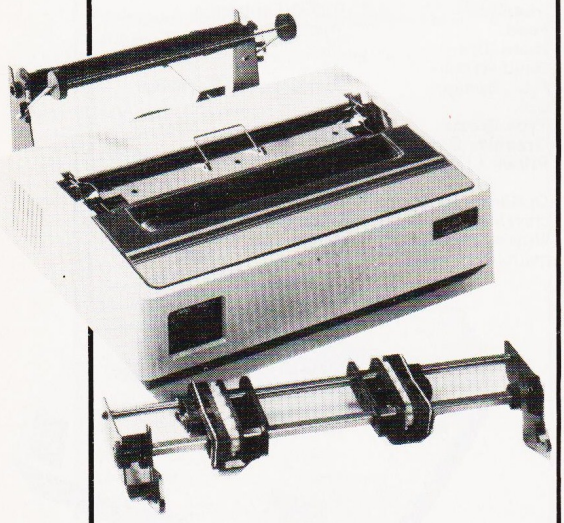
Options:- Tractor feed, programmable character set.
Notes:- First of a new generation of matrix printers, like the BASE 2 and EPSON.

NEWBURY LABS

8300 RM
Dist:- Newbear Computing Store,
40 Bartholomew Street,
Newbury, Berkshire
0635-30505

Face:-	Dot
Interface:-	RS232
Feed:-	Tractor
Head Size:-	7x9
Baud Rates:-	110-9600
Print Speed:-	125cps
Col:-	
Type Sizes:-	2
Graphics Option:-	No
Price:-	£525

Options:- Choice of character per line and buffer sizes.
Notes:- General purpose dot matrix printer.



OKI

MICROLINE 80
Dist:- Rohan Computing
52 Coventry Street,
Southam, Warcs CV 0EP
092681-4045

Face:-	Dot
Interface:-	Centronics
Feed:-	Friction
Head Size:-	9x7
Baud Rates:-	—
Print Speed:-	80cps
Col:-	80
Type Sizes:-	3
Graphics Option:-	Yes
Price:-	£399

Options:- Tractor feed, RS232 1200 Baud interface
Notes:- One of the new generation of micro printers for small business and personal use.

MICROLINE 82

Face:-	Dot
Interface:-	RS232/Centronics
Feed:-	Friction/Sprocket
Head Size:-	9x7
Baud Rates:-	1200
Print Speed:-	80cps (bi-directional)
Col:-	80/132
Type Sizes:-	3
Graphics Option:-	Yes
Price:-	£550

Notes:- Bi-directional version of the MICROLINE 80 with form controls.

MICROLINE 83

Face:-	Dot
Interface:-	RS232/Centronics
Feed:-	Friction/Sprocket
Head Size:-	9x7
Baud Rates:-	1200
Print Speed:-	120cps (bi-directional)
Col:-	132/136
Type Sizes:-	3
Graphics Option:-	Yes
Price:-	£799

Notes:- Full width version of MICROLINE range.

OLIVETTI

DY 311
Dist:- Dealership currently under negotiation.

Face:-	Daisy
Interface:-	RS232/IEEE
Feed:-	Tractor/Friction
Head Size:-	N/A
Baud Rates:-	110-9600
Print Speed:-	32cps
Col:-	
Type Sizes:-	Various
Graphics Option:-	—
Price:-	£1,300

Options:- Sheet feeder, 20mA interface
Notes:- High quality daisy system with full proportional spacing and tabbing.

TH 240

Face:-	Dot/Thermal
Interface:-	RS232
Feed:-	Tractor/Friction
Head Size:-	7 pin
Baud Rates:-	110-9600
Print Speed:-	320cps
Col:-	
Type Sizes:-	—
Graphics Option:-	Yes
Price:-	£860

Options:- High speed plot, paper handling accessories.
Notes:- Thermal printer capable of producing eight ISO alphabets.

PAPER TIGER

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

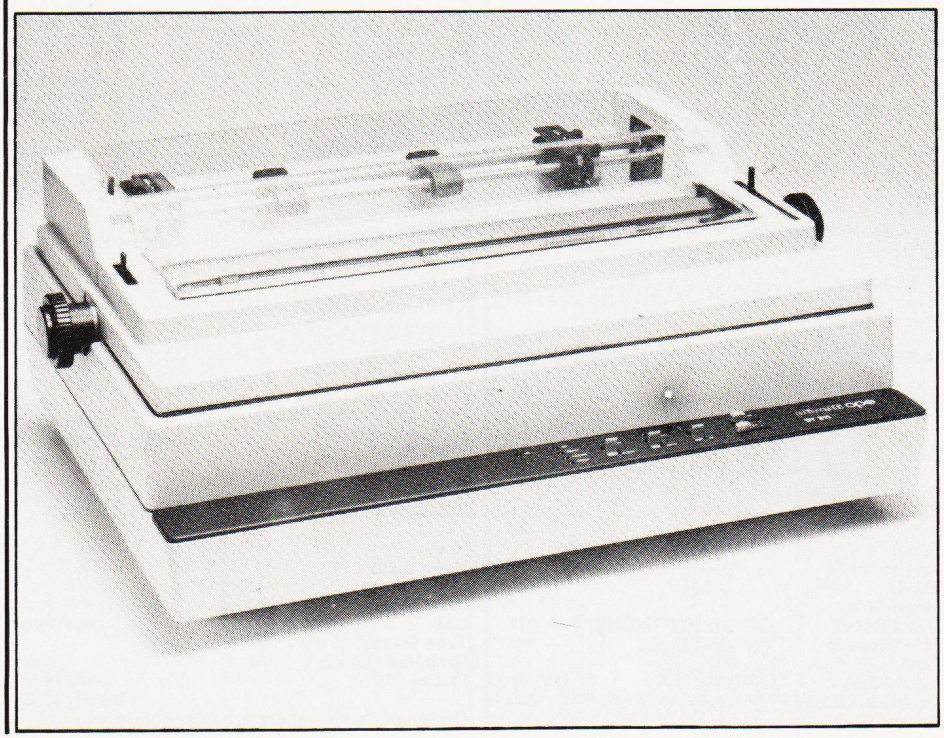
+ regional outlets inc. Teleprinter Equipment

Face:-	Dot
Interface:-	RS232/Centronics
Feed:-	Tractor/Friction
Head Size:-	7x7
Baud Rates:-	110-1200
Print Speed:-	95cps
Col:-	132
Type Sizes:-	4
Graphics Option:-	Yes
Price:-	£598

Notes:- Very versatile printer with various built-in options for line length, etc.

PAPER TIGER 460

Face:-	Dot
Interface:-	RS232/Centronics
Feed:-	Tractor
Head Size:-	Staggered nx9
Baud Rates:-	300-9600
Print Speed:-	110-160cps bi-directional
Col:-	80
Type Sizes:-	3
Graphics Option:-	High res
Price:-	£—



PAPER TIGER 560
Dist:- Teleprinter Equipment,
Akeman Street, Tring, Herts HP23 6AJ
044282-4011

Face:-	Dot
Interface:-	RS232/Centronics
Feed:-	Sprocket
Head Size:-	Staggered nx9
Baud Rates:-	300-9600
Print Speed:-	110-160 (bi-directional)
Col:-	132
Type Sizes:-	8
Graphics Option:-	Yes
Price:-	—

Notes:- Full width version of popular matrix printer.

PERTEC

STYLIST 360
Manuf:- Pertec International
10 Portman Road, Reading,
Berkshire RG3 1DU
0734-582115

Face:-	Daisy
Interface:-	Centronics
Feed:-	Friction
Head Size:-	—
Baud Rates:-	—
Print Speed:-	17cps
Col:-	132/198
Type Sizes:-	Various
Graphics Option:-	No
Price:-	£666

PERTEC P80

Face:-	Dot
Interface:-	Centronics
Feed:-	Friction/Sprocket
Head Size:-	7x9
Baud Rates:-	110-9600
Print Speed:-	80cps (bi-directional)
Col:-	80/120
Type Sizes:-	2
Graphics Option:-	No
Price:-	£478

Options:- RS232 or 20mA interfaces.

PERTEC P250

Face:-	Dot
Interface:-	RS232
Feed:-	Tractor
Head Size:-	7x9
Baud Rates:-	110-19,200
Print Speed:-	250cps (bi-directional)
Col:-	132/158/198
Type Sizes:-	3
Graphics Option:-	Yes
Price:-	£1,311

Options:- Centronics and 20mA interfaces.

QUME

SPRINT 5
Dist:- Facit Data Products Ltd.
Maidstone Road, Rochester, Kent.
0634-401721

Local distribution by: Access Data, Fortronics, Cytec, Wilkes, Rohan, Brospa etc.

Face:-	Daisy
Interface:-	RS232/20mA/Parallel
Feed:-	Tractor/Friction
Head Size:-	N/A
Baud Rates:-	110-1200
Print Speed:-	45-55cps
Col:-	132/158
Type Sizes:-	Various
Graphics Option:-	Yes
Price:-	From £1,625

Options:- RO or KSR terminals, single sheet feed
Notes:- High quality correspondence printer.

ROBETRON

ROBETRON 1152
Dist:- Kingston Computers Ltd.,
Scarborough House, Scarborough Road,
Bridlington, Yorkshire.
0262-73036

Face:-	Daisy
Interface:-	Centronics
Feed:-	Friction
Head Size:-	N/A
Baud Rates:-	–
Print Speed:-	45cps
Col:-	
Type Sizes:-	various
Graphics Option:-	No
Price:-	under £1,000

Options:- Interfaces, tractor feed.
Notes:- East German RO daisy printer for high quality type.

SEIKO

SEIKOSHA GP-80
Dist:- Mitecrest Ltd.,
61, New Market Square, Basingstoke,
Hants RG21 1HW
0256-56468

Face:-	Dot
Interface:-	Centronics
Feed:-	Tractor/Friction
Head Size:-	'unihammer'
Baud Rates:-	–
Print Speed:-	30cps
Col:-	80
Type Sizes:-	–
Graphics Option:-	Yes
Price:-	£199

Options:- Various interfaces.
Notes:- Amazingly low cost single needle printer capable of reasonable print and graphics quality.

SIGMA

MODEL 801
Dist:- Sigma UK
Unit 2, 106-120 Garrat Lane,
Wandsworth, London SW18
01-870 4524

Face:-	Dot
Interface:-	RS232/20mA/Centronics
Feed:-	Tractor/Friction
Head Size:-	7x7
Baud Rates:-	110-1200
Print Speed:-	132cps
Col:-	
Type Sizes:-	–
Graphics Option:-	–
Price:-	£695

TELETYPE

TELETYPE 43
Dist:- Peripheral Hardware Ltd.,
Armfield Close, West Molesey, Surrey.
01-941 4806

Face:-	Dot
Interface:-	RS232/20mA
Feed:-	Tractor/Friction
Head Size:-	7x9
Baud Rates:-	–
Print Speed:-	10 or 30cps
Col:-	132
Type Sizes:-	–
Graphics Option:-	No
Price:-	

Options:- IEEE interface, Buffer store, Stand, ASR.
Notes:- High quality matrix terminal available as KSR, ASR or RO. Portable and TTY compatible.

TEXAS INSTRUMENTS

TI 810
Dist:- Texas Instruments,
Manton Lane, Bedford.
0234-67466

Face:-	Dot
Interface:-	RS232
Feed:-	Tractor
Head Size:-	9x7
Baud Rates:-	110-9600
Print Speed:-	150cps
Col:-	132
Type Sizes:-	2
Graphics Option:-	–
Price:-	£1,450

Options:- Character sets, various interfaces, form handling.

TI 820

Face:-	Dot
Interface:-	RS232
Feed:-	Tractor
Head Size:-	9x7
Baud Rates:-	110-9600
Print Speed:-	150cps
Col:-	
Type Sizes:-	2
Graphics Option:-	–
Price:-	£1,450 - £1,650

Notes:- KSR bi-directional with RO option at reduced cost.

TI 825

Face:-	Dot
Interface:-	RS232
Feed:-	Tractor
Head Size:-	9x7
Baud Rates:-	110-600
Print Speed:-	75cps
Col:-	
Type Sizes:-	2
Graphics Option:-	–
Price:-	£1,095 - £1,250

Notes:- Slower RO or KSR matrix printer.

TI 743

Face:-	Dot Thermal
Interface:-	RS232/20mA
Feed:-	Friction
Head Size:-	5x7
Baud Rates:-	110-300
Print Speed:-	30cps
Col:-	
Type Sizes:-	–
Graphics Option:-	–
Price:-	£995 -£1,105

Notes:- Thermal printer KSR terminal.

TI 745

Face:-	Dot Thermal
Interface:-	RS232
Feed:-	Friction
Head Size:-	5x7
Baud Rates:-	110-300
Print Speed:-	30cps
Col:-	
Type Sizes:-	–
Graphics Option:-	–
Price:-	£1,250

Notes:- Integral modem in portable terminal.

TI 763

Face:-	Dot Thermal
Interface:-	RS232/20mA
Feed:-	Friction
Head Size:-	5x7
Baud Rates:-	110-9600
Print Speed:-	30cps
Col:-	
Type Sizes:-	–
Graphics Option:-	–
Price:-	£2,195

Options:- Expanded character store.
Notes:- Bubble memory based terminal with 20K internal storage.

RICOH

RICOH RP1600
Dist:- Nexos (UK) Ltd.,
Metropolitan House, 1 Hagley Road,
Edgbaston, Birmingham B16 8TG
021-454 2235

Face:-	Daisy
Interface:-	Centronics
Feed:-	Friction
Head Size:-	N/A
Baud Rates:-	–
Print Speed:-	60cps
Col:-	N/A
Type Sizes:-	various
Graphics Option:-	–
Price:-	£1,290

Options:- Various interfaces.
Notes:- Fast commercial daisy wheel for WP and other office applications.

TRENDCOM

TCM 100 .
Dist:- Personal Computers Ltd.
194-200 Bishopsgate,
London EC2M 4NR

Face:-	Dot Thermal
Interface:-	Parallel
Feed:-	Friction
Head Size:-	5x7
Baud Rates:-	–
Print Speed:-	40cps
Col:-	40
Type Sizes:-	–
Graphics Option:-	Yes
Price:-	£240

Options:- Interfaces for various machines.
Notes:- 40 column thermal printer capable of graphics plotting.

TCM 200

Face:-	Dot Thermal
Interface:-	Parallel
Feed:-	Friction
Head Size:-	5x7
Baud Rates:-	–
Print Speed:-	40cps
Col:-	80
Type Sizes:-	–
Graphics Option:-	Yes
Price:-	£340

Options:- Interfaces for various machines.
Notes:- 80 column version of TCM 100.

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:-	£349

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

WALTERS MICROSYSTEMS

DOLPHIN BD-80P
Manuf:- Walters Microsystems
1 Blenheim Road,
High Wycombe, Bucks
0494-445172

Face:-	Dot
Interface:-	RS232/20mA/Centronics/ IEEE
Feed:-	Tractor/Friction
Head Size:-	7x9
Baud Rates:-	50-19,200
Print Speed:-	125cps
Col:-	80/132
Type Sizes:-	2
Graphics Option:-	Yes
Price:-	£525

Options:- Stand, Buffer, Coms interface.
Notes:- A standard matrix printer with excellent reliability reputation.

DOLPHIN BD-136

Face:-	Dot
Interface:-	RS232/Parallel/Centronics/ IEEE/20mA
Feed:-	Friction/Sprocket/Tractor
Head Size:-	9x9
Baud Rates:-	—
Print Speed:-	240cps (bi-directional)
Col:-	136
Type Sizes:-	—
Graphics Option:-	Yes
Price:-	£1,200

Notes:- Flexible, intelligent matrix printer capable of a wide formatting range.

WEYFRINGE

MODEL 480
Dist:- Weyfringe
Longbeck Road, Marske,
Redcar, Cleveland TS11 6HQ
0642-470121

Face:-	Dot
Interface:-	RS232/20mA/Centronics
Feed:-	Friction
Head Size:-	5x7
Baud Rates:-	110-9600
Print Speed:-	110cps
Col:-	40
Type Sizes:-	2
Graphics Option:-	—
Price:-	£475

Options:- Choice of indicated interfaces.
Notes:- Tally roll printer for logging applications.

CENTURY

Face:-	Dot
Interface:-	RS232/20mA/Centronics
Feed:-	Tractor/Friction
Head Size:-	7x9
Baud Rates:-	110-9600
Print Speed:-	110cps
Col:-	96/132
Type Sizes:-	4
Graphics Option:-	—
Price:-	£945

Options:- Optional PET interface, alternate character set.
Notes:- General purpose machine with form handling facilities, Now available with keyboard.

WHYMARK

WHYMARK 201
Dist:- Whymark Instruments
6 Holmesdale Road,
Reigate, Surrey RH2 0BQ
07372-21753

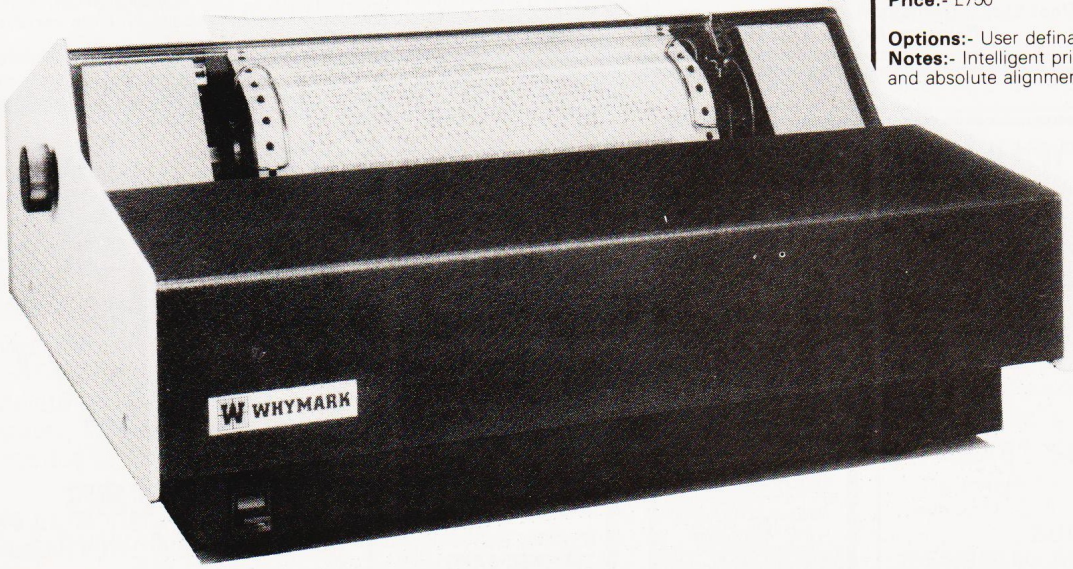
Face:-	Dot
Interface:-	RS232/20mA/Centronics/ IEEE/Parallel
Feed:-	Friction
Head Size:-	7x7
Baud Rates:-	110-4800
Print Speed:-	1 lps
Col:-	40
Type Sizes:-	4
Graphics Option:-	—
Price:-	£410 - £490

Options:- Label printer, rack mounted, interfaces to order.
Notes:- Tally roll printer with 40 character line.

WHYMARK 801

Face:-	Dot
Interface:-	RS232/Centronics/IEEE
Feed:-	Tractor
Head Size:-	nx7
Baud Rates:-	75-9600
Print Speed:-	140cps
Col:-	120
Type Sizes:-	2
Graphics Option:-	Yes
Price:-	£750

Options:- User definable character set, stand.
Notes:- Intelligent printer with proportional control and absolute alignment.



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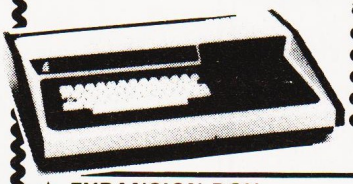

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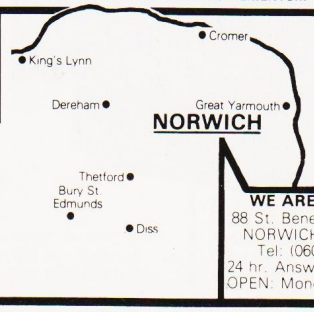

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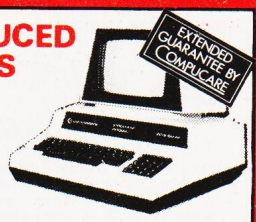

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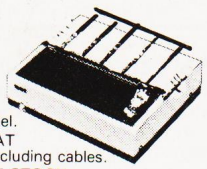

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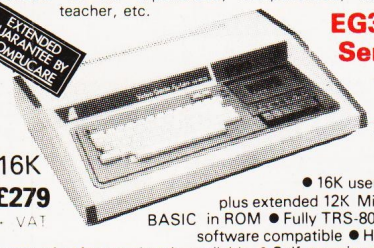

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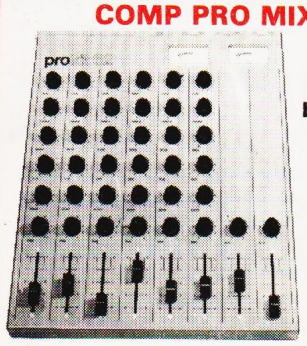

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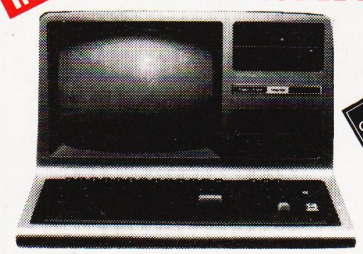

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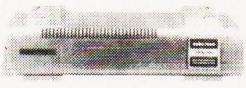

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Lowe Electronics are further enhancing the versatility of the Genie system: we have designed lower case adaptor, sound kit and now colour systems. This will be available from April and is shown in action below.
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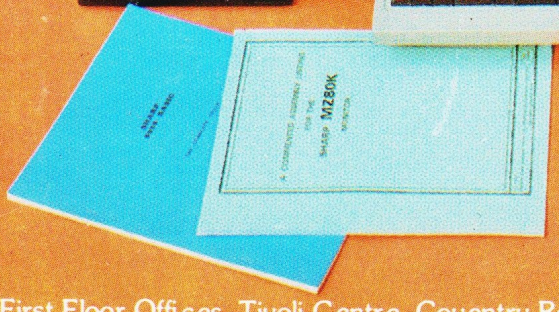

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