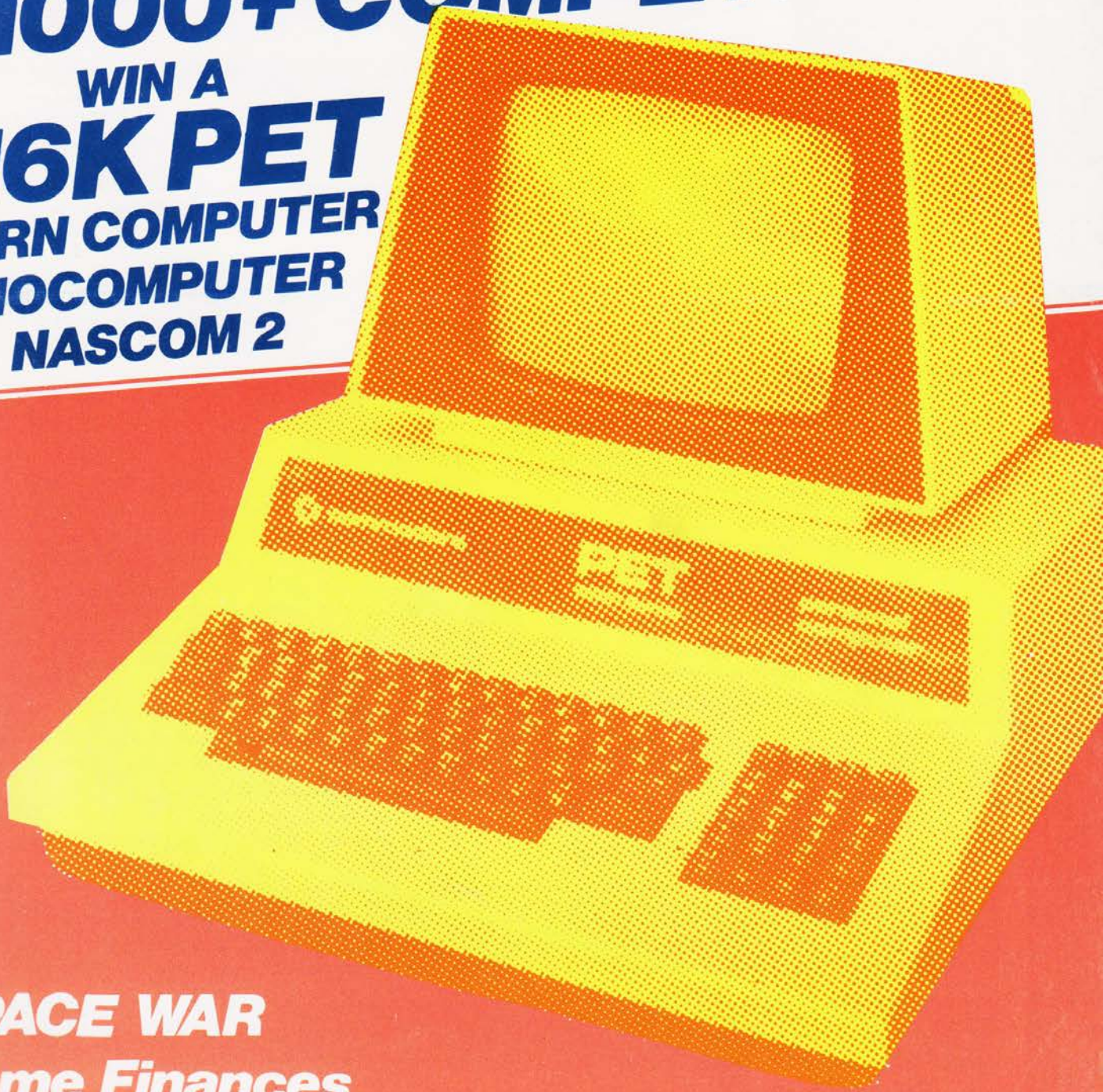
computing today

ISSN 0142-7210
MAR 1980
50p

IT'S OUR BIRTHDAY!

£1000+ COMPETITION

WIN A
16K PET
ACORN COMPUTER
NANOCOMPUTER
NASCOM 2



SPACE WAR
Home Finances
Modem Project
Apple Of Whose Eye?

8K ON BOARD MEMORY!
5K RAM, 3K ROM or 4K RAM, 4K ROM (link selectable). Kit supplied with 3K RAM, 3K ROM. System expandable for up to 32K memory.

2 KEYBOARDS!
56 Key alphanumeric keyboard for entering high level language plus 16 key Hex pad for easy entry of machine code.

GRAPHICS!
64 character graphics option — includes transistor symbols! Only £18.20 extra!

MEMORY MAPPED
high resolution VDU circuitry using discrete TTL for extra flexibility. Has its own 2K memory to give 32 lines for 64 characters.

KANSAS CITY
low error rate tape interface.

Cabinet size 19.0" × 15.7" × 3.3". Television by courtesy of Rumblelows Ltd., price £58.62

2 MICROPROCESSORS
Z80 the powerful CPU with 158 instruction, including all 78 of the 8080, controls the MM57109 number cruncher. Functions include +, —, *, /, squares, roots, logs, exponentials, trig functions, inverses etc. Range 10^{-99} to 9×19^{99} to 8 figures plus 2 exponent digits.

EFFICIENT OPERATION
Why waste valuable memory on sub routines for numeric processing? The number cruncher handles everything internally!

RESIDENT BASIC
with extended mathematical capability. Only 2K memory used but more powerful than most 8K Basics!

1K MONITOR
resident in EPROM.

SINGLE BOARD DESIGN
Even keyboards and power supply circuitry on the superb quality double sided plated through-hole PCB.

NEW LOW PRICE!

COMPLETE KIT NOW ONLY £249 + VAT

Kit also available as separate packs: e.g. PCB, Keyboards, Cabinet, etc.

POWERTRAN

PSI Comp 80.Z80 Based powerful scientific computer
Design as published in Wireless World

The kit for this outstandingly practical design by John Adams published in a series of articles in Wireless World really is complete!

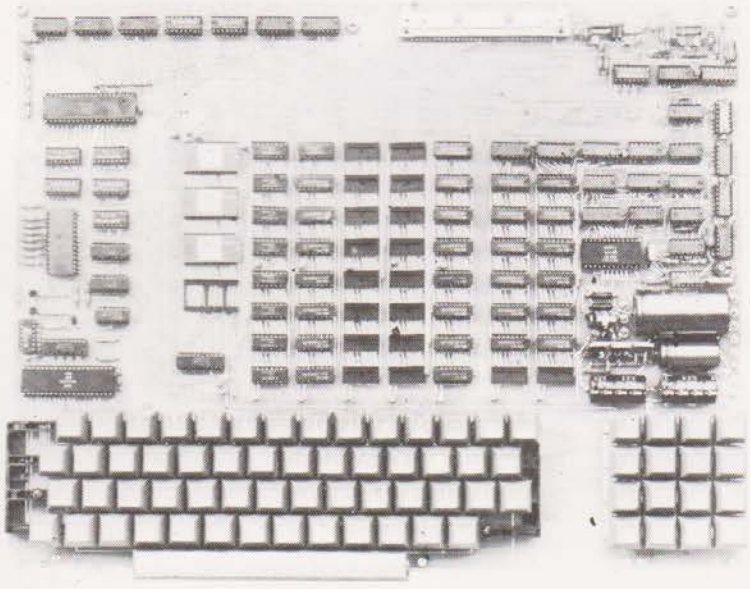
Included in the PSI COMP 80 scientific computer kit is a professionally finished cabinet, fibre-glass double sided, plated-through-hole printed circuit board, 2 keyboards PCB mounted for ease of construction, IC sockets, high reliability metal oxide resistors, power supply using custom designed toroidal transformer, 2K Basic and 1K monitor in EPROMS and, of course, wire, nuts, bolts, etc.

PSI COMP 80 Memory Expansion System

Expansion up to 32K all inside the computer's own cabinet!
By carefully thought out engineering a mother board with buffers and its own power supply (powered by the computers transformer) enables up to 3 8K RAM or 8K ROM boards to be fitted neatly inside the computer cabinet. Connections to the mother board from the main board expansion socket is made via a ribbon cable.

Mother Board	Fibre glass double sided plated through hole P.C.B. 8.7" x 3.0" set of all components including all brackets, fixing parts and ribbon cable with socket to connect to expansion plug	**£39.90**
8K Static RAM Board	Fibre glass double sided plated through hole P.C.B. 5.6" x 4.8"	**£12.50**
	Set of components including IC sockets, plug and socket but excluding RAMs.	**£11.20**
	2114L RAM (16 required)	**£5.00**
	Complete set of board, components, 16 RAMS	**£89.50**
8K ROM Board	Fibre glass double sided plated through hole P.C.B. 5.6" x 4.8"	**£12.40**
	Set of components including IC sockets, plug and socket but excluding ROMs	**£10.70**
	2708 ROM (8 required)	**£8.00**
	Complete set of board, components, 8 ROMs	**£78.50**

Floppy Disk, PROM programmer and printer interface coming shortly!



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POWERTRAN COMPUTERS

(a division of POWERTRAN ELECTRONICS)

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computing today

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MARCH 1980

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HAPPY BIRTHDAY TO US!
p.38

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Britain's first comp

A complete personal computer for a third of the price of a bare board.

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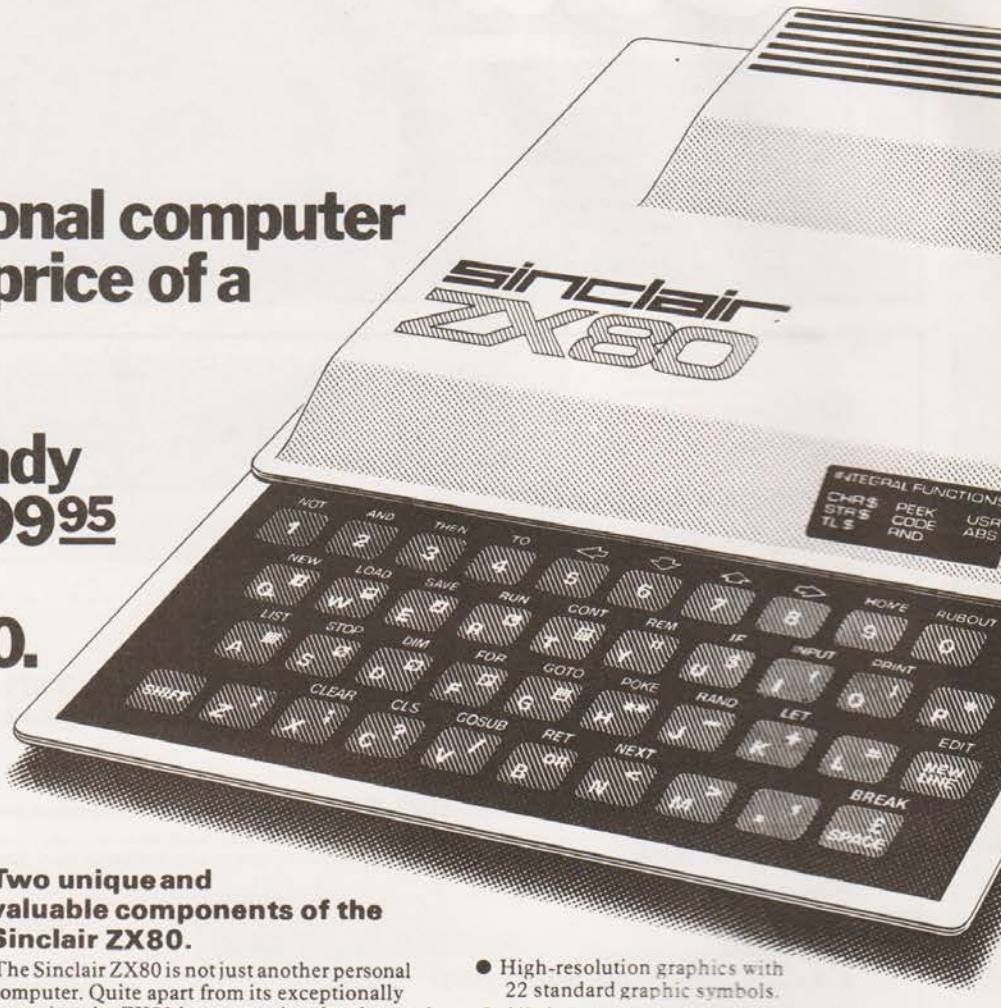
The Sinclair ZX80.



Until now, building your own computer could easily cost around £300 – and still leave you with only a bare board for your trouble.

The Sinclair ZX80 changes all that. For just £79.95 you get *everything* you need to build a personal computer at home... PCB, with IC sockets for all ICs; case; leads for direct connection to your own cassette recorder and television; everything!

And yet the ZX80 really is a complete, powerful, full-facility computer, matching or surpassing other personal computers on the market at several times the price. The ZX80 is programmed in BASIC, and you could use it to do quite literally anything from playing chess to running a power station.

The ZX80 is pleasantly straightforward to assemble, using a fine-tipped soldering iron. Once assembled, it immediately proves what a good job you've done. Connect it to your TV set... link it to an appropriate power source*... and you're ready to go.

Your ZX80 kit contains...

- Printed circuit board, with IC sockets for all ICs.
- Complete components set, including all ICs – all manufactured by selected world-leading suppliers.
- New rugged Sinclair keyboard, touch-sensitive, wipe-clean.
- Ready-moulded case.
- Leads and plugs for connection to any portable cassette recorder (to store programs) and domestic TV (to act as VDU).
- FREE course in BASIC programming and user manual.

Optional extras

- Mains adaptor of 600 mA at 9 V DC nominal unregulated (available separately – see coupon).
- Additional memory expansion board plugs in to take up to 3K bytes extra RAM chips. (Chips also available – see coupon.)

*Use a 600 mA at 9 V DC nominal unregulated mains adaptor. Available from Sinclair if desired (see coupon)

Two unique and valuable components of the Sinclair ZX80.

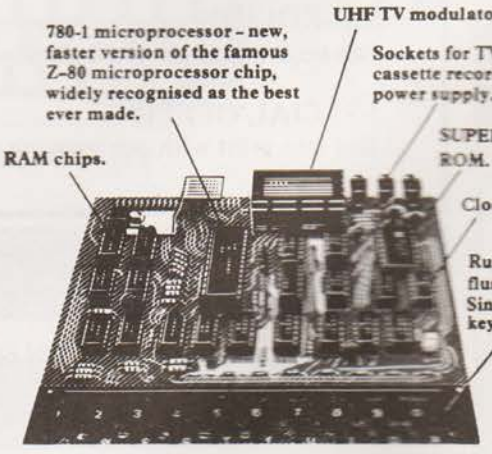
The Sinclair ZX80 is not just another personal computer. Quite apart from its exceptionally low price, the ZX80 has two uniquely advanced components: the Sinclair BASIC interpreter; and the Sinclair teach-yourself BASIC manual.

The unique Sinclair BASIC interpreter... offers remarkable programming advantages:

- **Unique 'one-touch' key word entry: the ZX80 eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.**
- Unique syntax check. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them.
- Excellent string-handling capability – takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The ZX80 also has string input-to request a line of text when necessary. Strings do *not* need to be dimensioned.
- Up to 26 single dimension arrays.
- FOR/NEXT loops nested up 26.
- Variable names of any length.
- BASIC language also handles full Boolean arithmetic, conditional expressions, etc.
- Exceptionally powerful edit facilities, allows modification of existing program lines.
- Randomise function, useful for games and secret codes, as well as more serious applications.
- Timer under program control.
- PEEK and POKE enable entry of machine code instructions, USR causes jump to a user's machine language sub-routine.
- High-resolution graphics with 22 standard graphic symbols.
- All characters printable in reverse under program control.
- Lines of unlimited length.

...and the Sinclair teach-yourself BASIC manual.

If the features of the Sinclair interpreter listed alongside mean little to you–don't worry. They're all explained in the specially-written 96-page book *free* with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming – from first principles to complex programs. (Available separately – purchase price refunded if you buy a ZX80 later.)



plete computer kit.

£79.95
Including VAT.
Including post and packing.
Including all leads and components

Fewer chips, compact design, volume production – more power per pound!

The ZX80 owes its remarkable low price to its remarkable design: the whole system is packed onto fewer, newer, more powerful and advanced LSI chips. A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system, and monitor. And the ZX80's 1K byte RAM is roughly equivalent to 4K bytes in a conventional computer, because the ZX80's brilliant design packs the RAM so much more tightly. (Key words, for instance, occupy just a single byte.)

To all that, add volume production – and you've that rare thing: a price breakthrough that really *is* a breakthrough.

The Sinclair ZX80. Kit: £79.95. Assembled: £99.95. Complete!

The ZX80 kit costs a mere £79.95. Can't wait to have a ZX80 up and running? No problem! It's also available, ready assembled, for only £99.95.

Whether you choose the kit or the ready-made, you can be sure of world-famous Sinclair technology – and years of satisfying use. (Science of Cambridge Ltd is one of the Sinclair companies owned and run by Clive Sinclair.)

To order, complete the coupon, and post to Science of Cambridge for delivery within 28 days. Return as received within 14 days for full money refund if not completely satisfied.

sinclair ZX80

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Remember: all prices shown *include* VAT, postage and packing. No hidden extras.

Please send me:

Quantity	Item	Item price £	Total £
	Sinclair ZX80 Personal Computer kit(s). Price includes ZX80 BASIC manual, excludes mains adaptor.	79.95	
	Ready-assembled Sinclair ZX80 Personal Computer(s). Price includes ZX80 BASIC manual, excludes mains adaptor.	99.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	8.95	
	Memory Expansion Board(s) (takes up to 3K bytes).	12.00	
	RAM Memory chips – standard 1K bytes capacity.	16.00	
	Sinclair ZX80 Manual(s) (manual free with every ZX80 kit or ready-made computer).	5.00	
NB. Your Sinclair ZX80 may qualify as a business expense.		TOTAL	£

I enclose a cheque/postal order payable to Science of Cambridge Ltd for £ _____

Please print
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CT/3/80

SOFTWARE BONANZA

Bumper bundles are in again this month with a veritable pile of stuff from Petsoft. To start the New Year they are chopping large sums of money off some of their business packages, namely the Sales and Purchase Ledger programs. Prices are now £95 for cassette and £115 for disk based versions. It is hoped to offer a complete range of the business packs for less than £100 a program very soon. With the new marketing agreements for five European countries and Australia they are expecting to sell 100,000 before Easter, perhaps this means a platinum for some lucky person. One of Petsofts new offering is a Job Evaluation package, selling at £25. Designed for managers and personnel departments it uses a multiple regression analysis to produce a Job Evaluation Formula from a set of data produced by the employees. Another new package in the business range is the Sales invoicing program. The program is capable of being stand-alone and handles product descriptions, prices, VAT rates and terms of trade etc. Cost is £350 and this includes a training course. Finally in this month's Petsoft plug is a Timetabling program, designed to help teachers with multiple option courses sort things out. Designed by Oxford Systems it is said to decimate the time required to do things manually, we wondered if this meant that it worked in BCD? The program has been field tested and costs £95 and is designed for the 32K PET. For details on all the above offerings contact Petsoft at 66–68 Hagley Road, Edgbaston, Birmingham B16 8PF.

Stop Press:
Petsoft are today, 8th Feb, launching their new Word Pro-

FASTER THAN ROM

Texas Instruments have launched a new 8K EPROM with an access time of 250 nanoseconds. Designated the TMS2508-25 it is compatible with other family members such as the 2516 and requires a single 5 V supply. The chip can be erased under conventional UV and is capable of being programmed sequentially, singly or in block modes. The chip should be available from all TI distributors.

TAKE IT WITH YOU

Portable Microsystems are expanding their range of portable machines with a system called TERA. This is a mobile data terminal which uses FM radio to report back to the main computer, Breaker One Four? The terminal has a full alphanumeric keypad and a 64 character display and a typical range of one mile. The companion network controller runs through the landlines or is hard wired and uses RS232 protocol. TERA can support up to 250 terminals and there is a bar code wand option. Also new from PM is a digital logic trainer called ELT 100 suitable as a stand-alone educational tool or in the classroom. Contact Portable Microsystems at Forby House, 18 Market Place, Brackley, Northants.

cessor. Written in machine code and priced at £325 it is comparable in performance to purpose built systems and will be supplied with full documentation. For full details contact your local dealer or Petsoft at the above address.

AT LAST!

Do your copies of Computing Today get dog-eared and dejected? Does your better half throw them away each month? Solve all these common problems with one of our smart new binders. Available in glowing red with our logo on the spine in midnight black they will make a welcome sight on your bookshelf, and you will be sure of your copies' safety. At the bargain price of £3.20 all in they will not break the bank either!

Order yours direct from our offices but please keep the order separate from any other mail and mark the envelope "BINDERS".

CHUNKY STUFF

This months hardware news is on RAMs, 'n things that go round, so if you are all sitting comfortably . . . . Intel have released a new bunch of RAM in 1K by 4 to complement the faithful 2114. It not only goes faster but uses less juice as well. Identification is by the suffix A, a typical example being 2114AL -2. They are fully compatible with the earlier versions and access time is reduced by typically 50%, power is 40% down. Intel have also launched a cartridge based development system with a 7.3 Mb external cartridge disk and a 250K floppy as well. The system is intended for 8086 and 8085 users who wish to develop large programs faster. The disk unit is available separately. System configuration is 64K RAM, 4K ROM, 2K VDU, detachable ASCII keyboard and the disk unit. For more information contact Intel at 4 Between Towns Road, Cowley, Oxford OX4 3NB. Rapid Recall have a couple of new offerings this month, the first is a floppy controller called iSBC 204. It is fully compatible with Intel single board machines and most soft sectored, single density standard and mini floppies. RR are also supplying an analogue in, analogue out machine designated the 2920. All major functions are under software control and development is under an Intellec system. The processor is a 25 bit high speed one with EPROM and scratchpad RAM. There are four inputs and eight outputs which are multiplexed, converted, processed and then sent back to the outside world. Typical applications include complex filters, threshold detectors and rectifiers. For details contact Rapid Recall at 6 Soho Mills, Wooburn Industrial Park, Wooburn Green, Bucks.

DYNAMIC STUFF

Data Dynamics, the Hayes peripheral people, are now offering their range of ZIP terminals with a numeric keypad option. The twelve key pad has the usual numerics and "+" "." keys and is designed for people with large amounts of data to input. The ZIP terminals are now available in a vast variety of configuration including three dual standard models as well as a choice of 80 column tractor or friction and 132 column tractor printers. All the ZIP printers can now be fitted with a two colour print option. The modification is made by fitting a new ribbon transport that handles the SO and SI codes to select either black or red printing. For more info on all the ZIP range contact Data Dynamics at Data House, Springfield Road, Hayes, Middx.

CLUB CALL

Well, we didn't seem to make too many mistakes in our Club Survey of the other month. However we have had one or two late items so here they are. The East London Amateur Computer Club has got itself a new Chairman, Dr Graham Crisp who is contactable at 45 Leadale Avenue, Chingford, London E4 8AX or on 01-529 6010. The Thames Valley Amateur Computer Club are to meet in the Southcote Pub, in Southcote Lane, off the Bath Road in Reading from March. This means that the meetings will now be held on Tuesdays instead of Thursdays so the first one is on March 4th. Tiem of the meet is 7.00 for 7.30 and mines a pint of Best. And, finally, we have news of a newly forming club for all you people with TI58/59 programmable calculators. Called the Independent Texas Instruments TI 58/59 Users Group it is being co-ordinated by Paul Rees at Flat 2, No 1 Palatine Road, Withington, Manchester 20 and there is a program library and a newsletter.

KEY TO EXPAND

Keen Computers, the Nottingham based Apple specialists, are to expand in the new year with a London store. Opening somewhere in South London in January it will become a sales and service base for the South East but the main Nottingham center will still be used for special skills such as programming. For more details contact Dr Tim Keen at 5 The Poultry, Market Square, Nottingham or ring on 0602-583254.

CLOCK THIS ONE

Ingersoll, the watch people who moved into TV games not so long ago, have been appointed the sole distributors of the new Atari Video Computer System. Designated the 400/800 series they are being described as "the world's most advanced home computers". The press sheet goes on to say that they are designed and built to a high degree of reliability and engineered to accept "ROM, RAM, cassette tape, floppy disk and bubble memories". The units are designed to plug into your colour TV, and hopefully that means PAL encoded, and they feature all the usual goodies such as full colour, four sound voices, music synthesis, light pen, modem and "utilise high speed printers". The 800 model is shipped with 8K RAM, expands to 48K, 8K ROM, expands to 40K, and is based on the 6502. It can also handle up to four floppies and has an ASCII keyboard. .The language is Atari BASIC, presumably a Microsoft type. Prices of these machines will range from below £400 to under £750, it is expected that demand will exceed supply in the US until the end of 81. We have asked to see one so perhaps we shall be able to tell you more soon, but, for the meantime, contact Ingersoll at 202 New North Road, London N1 7BL.

NEW UNBEATABLE 1980 PRICES NOW!

EXPLORER/85

FEATURES INTEL 8085 cpu WITH ON BOARD S-100 EXPANSION

FLEXIBILITY: Real flexibility at LAST. The EXPLORER/85 features the Intel 8085 cpu 100% compatible with all 8080A and 8085 software. Runs at 3Mhz. Mother Board (Level A) with 2, S-100 pads expandable to 6 (Level C).
MEMORY: 2K Monitor ROM — 4K WORKSPACE/USER RAM — 1K Video RAM — 8K Microsoft BASIC in ROM or Cassette.
INTERFACES: STANDALONE FULL ASC11 Keyboard Terminal, 32/64 characters per 16 lines. Cassette interface (with motor control and cassette-File Structure). RS-232/20Ma loop. 4, 8 bit: 1, 6 bit I/O ports, programmable 14 bit binary counter/timer. Direct interface for any S-100 Board. FULL Buffering Decoding for S-100n Bus pads. Wait state generator for slow memory. Each stage has separate 5v 1A regulator for improved isolation and freedom from cross talk. P.S.U. requirements:— 8v, 6.3v AC. Runs with North Star controller and Floppies/CPM. EXPLORER/85 is expandable to meet your own requirements with easy to obtain S-100 peripherals. EXPLORER/85 can be purchased in individual levels, kit form or wired and tested. OR as a package deal as above.

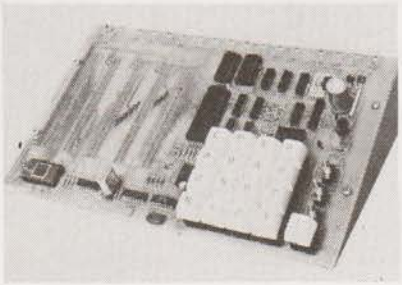
£275 + VAT
Microsoft BASIC on Cassette

£295 + VAT
Microsoft BASIC in ROM

AVAILABLE NOW!

We are killing inflation with ELF II

The tried and tested Microcomputer System that expands to meet your needs



COMPUTER KIT STARTS AT £59.95 + VAT

ELF II
Board with video output
FEATURING THE RCA COSMAC 1802 cpu

STOP reading about computers and get your "hands on" an ELF II and Tom Pitman's short course. ELF II demonstrates all the 91 commands which an RCA 1802 can execute and the short course speedily instructs you how to use them.
ELF II's VIDEO OUTPUT makes it unique among computers selling at such a modest price. The expanded ELF II is perfect for engineers, business, industry, scientific and educational purposes.

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ASC II Cab	£12.75
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LIGHT PEN	£6.00
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Short course on Tiny basic	£3.00
RCA 1802 manual	£3.00
Tex Editor Assembler, etc.	£12.75

ELF II BOARD SPECIFICATION
*RCA 1802 8-bit microprocessor with 256 byte RAM expandable to 64K bytes.
*RCA 1861 video IC to display program on TV screen via the RF Modulator Single Board with Professional hex keyboard – fully decoded to eliminate the waste of memory for keyboard decoding circuits. Load, run and memory protect switches. 15 Registers. Interrupt. DMA and ALU. Stable crystal clock. Built in power regulator. 5 slot plug in expansion bus (less connectors)

NEWTRONICS KEYBOARD TERMINAL AT £114.20 + VAT

The Newtronics Keyboard Terminal is a low cost stand alone Video Terminal that operates quietly and maintenance free. It will allow you to display on a monitor 16 lines of 64 characters or 16 lines of 32 characters on a modified TV, (RF Modulator required).
The characters can be any of the 96 ASC 11 alphanumerics and any of the 32 special characters, in addition to upper/lower case capability it has scroll-up features and full X-Y cursor control. All that is required from your microcomputer is 300 baud RS232-C or 20ma loop serial data plus a power source of 8v DC and 6.3v AC. The steel cabinet is finished in IBM Blue/Black. And if that is not enough the price is only **£114.20 + VAT as a kit**, or **£144.20 + VAT** assembled and tested. Plus £2 P & P (monitor not included).

THE ATARI VIDEO COMPUTER SYSTEM – £138 + VAT

Atari's Video Computer System now offers more than 1300 different game variations and options in twenty great Game Program TM cartridges!
Cartridges now available
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Basic Maths, Airsea Battle, Black Jack, Breakout, Surround, Spacewar, Video Olympics, Outlaw, Basketball, Hunt & Score*, Space War, Sky Diver, Air Sea Battle Codebreaker*, Miniature Golf

Extra Paddle Controllers — **£14.90** + VAT
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RACAL AP12, C12 TAPES: 10 for £4.50 + VAT
NOW AVAILABLE 8K FULL BASIC FOR ELF II
NEWSOFT GAMES FOR ELF II: 4 for £5 + VAT

SEND SAE FOR COMPREHENSIVE BROCHURE

Please add VAT to all prices (except manuals) P&P £2. Please make cheques and postal orders payable to **NEWTRONICS** or phone your order quoting BARCLAYCARD, ACCESS number.

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Mon-Sat 9.30-6.30pm near Highgate underground on main A1 into London

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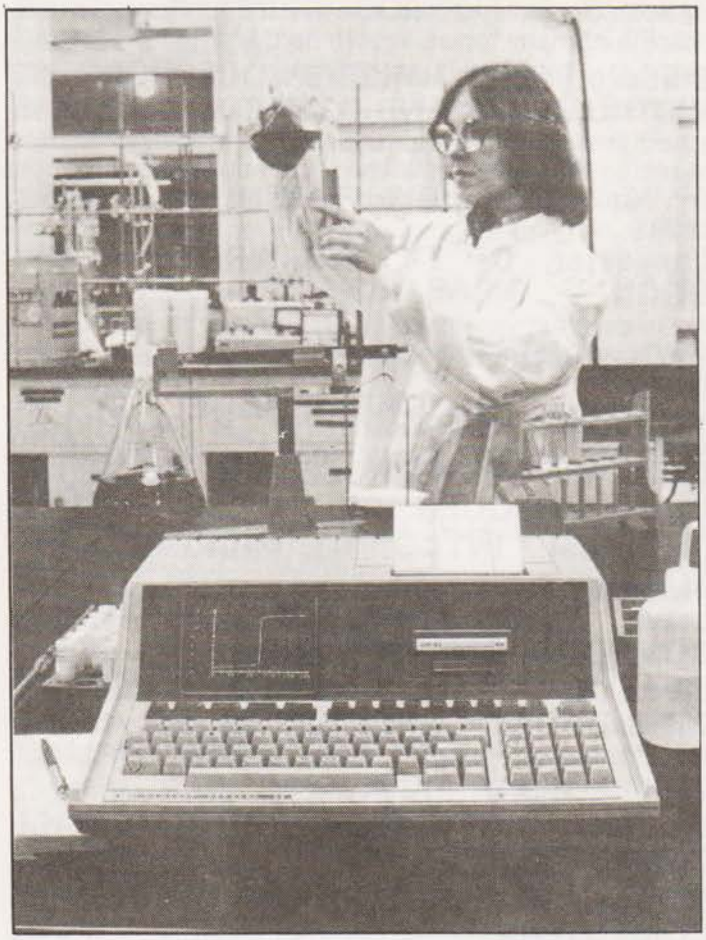

INSTANT OPINIONS

If you run what is popularly called a service establishment, such as a restaurant, hotel or supermarket you may be interested in a new micro-based device from MSI. The unit is called Tellus and it is a replacement for those on-the-spot interviews that everyone runs away from. The unit is free-standing and consists of a number of pushbuttons wired as answers to a variety of relevant questions. Up to eleven questions may be used and it is reckoned that it takes about 30 seconds to answer them, there is a choice of three answers to each, such as; good, bad or awful. When the questionnaire has been finished the customer presses record to save the answers for later analysis. Options available include a 12 column printer for instant results, extended memory to raise the capacity to 888 sets of answers and an accoustic coupler to connect the unit back to a head office. The unit runs from four standard batteries and costs between £1500 and £2500 depending on the options. For more information contact MSI at Data House, St Ives Road, Maidenhead, Berks.

HP HIT HOME

The calculator and desk-top mini people, Hewlett Packard, have moved into the personal computer market with their new model 85. Designed as a personal computer for engineers and scientists, among others, it is probably the first low-cost, high performance machine yet announced. Its main features are the 16K of dynamic memory (controlled by one chip) of which 14.5K is user accessible, 32Ks worth of BASIC and operating system, proper graphics, full ASCII and numeric keyboards with system control keys, built in 5" VDU with 16K of independant memory, a thermal printer/plotter that can copy direct from screen and the HP tape cartridge system that acts like a soft sectored floppy. The CPU is custom built, like many of the chips. The BASIC is to the latest ANSI standard and beyond and is complete with string functions, 12 digit accuracy, editing, built in security for data and programs plus a whole lot more. The tape storage system is based on that used in the HP minis but, unfortunately, not completely compatible. Each cartridge can store 217K and access is much faster than a conventional cassette because of a directory system to locate each program. Software will be available either immediately or in the near future and typical titles will be "BASIC Training", "Statistics" and "Electrical Engineering" – see what I mean about being professionally orientated. The whole works fits into a box 16" by 18" by 6", that's just a bit fatter than an Apple, and weighs under 20 pounds. Supplied with the machine is a 350 page manual and a set of fifteen useful programs along with a variety of other bits and pieces. Price of this very impressive machine is £1950 + VAT, expensive but still value for money if you are looking for a real computer and not a games machine. For more details contact HP at King Street Lane, Winnersh, Wokingham, Berks. We hope to have a sample in soon and will try to do a more detailed report in the near future.

FEED YOUR MICRO

A pet food and equipment wholesaler has installed an accounting package developed by Southwest Technical to assist in the production of invoices and stock control at less than £6000 per unit. The system is based around a single piece of paper which acts as the invoice, goods received, statement and cash posting document. Data is input through a VDU from the order and the system keeps track of the multiple discount structure as well as handling 5000 stock items and up to 1000 names and addresses. The program is written in BASIC and the system configuration includes floppy disks and a high speed printer to handle the three part stationery. All entries follow on-screen prompts for ease of use and average access time is 1.5 seconds. Staff training is included in the cost of the package, as is all hardware. For details contact SWT at 38 Dover Street, Piccadilly, London W1.

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Ian Sinclair

Having manipulated your data you need to be able to display it. All the details are explained in this months offering.

The Mk.14 manual contains several routines for mathematical work, such as multiplication, division, square root and greatest common divisor. These are interesting as exercises in number crunching, but they don't really represent the sort of job that an INS8060 is bought for, nor indeed was designed for. In addition, the methods (algorithms) which are used for some of the mathematical exercises will not be known to most users of the Mk.14. If we want to multiply numbers, it's a darn sight easier to use a calculator, and for really involved mathematics, a Texas TI-57 programmable calculator at around £25 will outperform virtually anything you can buy in the microprocessor/home computer line, with the exception of a certain device which uses a Z80 to control a separate number cruncher chip.

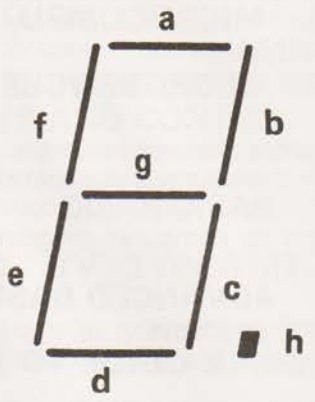
Programmed Display

What are microprocessors used for then? Well, one important use is the manipulation of data, and that's the use for which most computers are bought, even if the data amounts to some form of game. We'd better start on that sort of work right now – starting with the manipulation of the display, since that forms the basis of a whole lot of activities.

Now the display of the Mk.14 is a set of seven-segment displays which are under software control. This phrase means simply that the display sections are activated by data bytes from the microprocessor under the control of the monitor program. This is very different from the hardware control of the conventional BCD counter in which the counter outputs drive a decoder which in turn drives the seven-segment display. The hardware method will produce only the figures or letters which are obtainable from the decoder, nothing else. The display of the Mk.14, being driven by the monitor program, can also be controlled by a program written by yourself – if you know how. Here's how.

Each LED unit in the display (unit in this context means a group of seven segments, of which the Mk.14 has nine) is addressed like a memory location. Despite the name of the seven-segment display, there are actually eight segments, the eighth being the decimal point, so that each separate segment of a display can be controlled by one bit of a byte. Fig.1 shows how this is arranged, and what bit numbers will switch on what segments. We can turn on any combination of segments simply by using a byte which is the sum of the bits we want to turn on. For example, if we want to turn on segments a, b and c, we look up the bit numbers, which are 01, 02, 04 respectively, and add to make 07. The byte 07 fed as a data byte to the "memory" address of this unit will now turn on these segments. Remember that the addition has to be hexadecimal.

We can turn on any combination of segments, therefore, by writing a number to the correct address, so that we can generate any character which can be generated with a seven segment display, plus decimal point. Fig.2 shows a suggested list of figures and letters which can be displayed.



Segment	Binary code	Hex code
a	00000001	01
b	00000010	02
c	00000100	04
d	00001000	08
e	00010000	10
f	00100000	20
g	01000000	40
h	10000000	80

Fig.1. The seven segment display structure and the segment codes for the operation.

I've used a bit of imagination to list a small a (a) and a capital R, because a capital A and capital R can't be distinguished. With a few tricks of this kind, quite a large range of letters can be displayed, but M, K and W remain elusive!

Instructed To Send

Now how do we address each LED? This requires some knowledge of what the hardware does and how the monitor program is arranged. The memory decoding of the hardware, as you will remember from Part 7 of this series, arranges that the unit on the extreme right hadn side has the address 0D00. That's outside the range of addresses we can get by program-relative addressing from RAM (all of which is between 0F12 and 0FF8). The solution, which you snap out at once, is, of course, to use indexed addressing and a pointer register, and by convention we use pointer P1 for such exercises.

In the normal course of such things we would load the number 0D into the accumulator, then exchange (XPAH) with the high byte of P1, then load 00 and exchange with the low byte (XPAL). As it happens, we don't have to put these steps into a program to write directly to the display, because of the way in which the monitor program is arranged. Just as the monitor program "hands over" to your own program, the monitor program loads up the pointers P1 and P2, along with the accumulator, extension register and status register, from addresses 0FF9 to 0FFF in RAM, the highest addresses of the RAM. These addresses are kept clear for this purpose, the only part of RAM which is cleared when you reset or switch on at first, but there's no reason why you shouldn't make use of this feature to load up data bytes into the registers – we have already used this to read data from the accumulator (Part 8). By keying up 0FF9 (assuming we

Letter	Data byte
a	5F
b	7C
C or c	39 or 58
d	5E
E or e	79 or 7B
F	71
g	6F
h	74
i	06 or 30
J	2F
L	38
n	37
o	5C
P	73
r	33
S	6D
t	3D
U	3E
X(H)	76
y	6E
Z	5B
1	06 or 30
2	5B
3	4F
4	66
5	6D
6	7D
7	07
8	7F
9	67
0	3F
.	80

Fig.2. The authors' suggested list of display characters and their data codes.

remembered to press Abort first), and then Term, we can load in the byte 0D into 0FF9, so setting the high byte of P1 to this number. Because the monitor has cleared all of these addresses at reset, we don't need to load 00 into the next address, 0FFA to complete the address 0D00. It's as well, though, to use Mem to advance to 0FFA just to check that 00 is contained here. Remember also that if you reset at any time, these addresses will be cleared, and 0FF9 will have to be re-loaded.

This address, 0D00, is the address of LED zero, the one on the extreme right-hand side, so that any number written to this address will cause this particular unit to come on. Try the program in Fig.3. It starts with reset, to clear the registers in the event that you had a program running, and the keying in 0FF9 and Term allows you to set 0D, loading up pointer P1. Remember to use Mem to check 0FFA. The next step is Abort – NOT RESET. That's important, because if you use RESET, you'll reset the pointer registers and clear the addresses from 0FF9 up. Please don't write and say that they are not completely cleared, you have 20 stored in 0FFF. This happens after a program run, and is because the SENSE-B input is high – disregard it.

After pressing Abort, you can key in 0F20, out usual starting point for a program, press Term, and load in the program in the usual way. Press Abort again so that you can return 0F20, and then press GO. What happens?

It's not exactly unexpected – 0D00 has selected display unit 0, and the data byte which we're writing to this address is illuminating segment a of the display unit. Suppose we want to write a figure or letter in this part of the display instead of just a bar? Easy, at address 0F21 in the program of Fig.3, we simply insert whatever number code or sum of number codes we want, using the table in Fig.2. When the program runs, whatever you've selected in this way will appear at display unit 0. There I go, rabbitting on, and I haven't told you how to escape! The display program is an endless loop, meaning that the instructions will repeat until the loop is broken, and the keyboard ignores all other instructions while this is going on. There's nothing inside the program to make it stop, such as a timing instruction (later, lad, later), so the only way of getting out of it is to use RESET. This stops it all, and also clears pointer register P1. It doesn't clear the memory, and you'll find your program

Address	Data	Reminder
.....	RESET	.....
0FF9	0D	sets P1
.....	ABORT	.....
0F20	C4	load immediate
0F21	01	01
0F22	C9	store, indexed P1
0F23	00	zero displacement
0F24	90	jump. . . .
0F25	FA	to 0F20 again.

Fig.3. Wiring a byte to display segment 'nought'.

still loaded in the same place, but the program can't be run again until P1 is set up again to 0D00. If you want to play about with message writing, then it's a good idea to start the program with the section shown in Fig.4, and to run from the new starting address, 0F1D. This will load up P1 automatically for you on each run, so that the program is ready to operate again immediately after a reset. You can then modify the data byte for each run as you want, and observe the effect without having to load up P1.

Address	Data	Reminder
0F1D	C4	load immediate
0F1E	0D	0D
0F1F	35	XPAH(P1)

Start at 0F1D after resetting, so that P1 is correctly loaded.

Fig.4. Making the program easier to use, add it to Fig.3.

Writing To Them All

The next step from all this is to write something to each LED. There's no reason why we shouldn't do this in a completely obvious way, as we've shown in the program of Fig.5. Though this is a much longer program, there's no mystery about it. For each unit of the display, there's a load-immediate instruction (C4) which is followed by the number byte, the sum of the separate bar codes, for the number or letter to be written, and then a store instruction (C9) followed by a displacement. This store instruction is a P1 indexed instruction, and once again P1 has to be loaded, either by writing 0D into address 0FF9 immediately after resetting, or by including a P1 load in the program. The numbers which follow the C9 instruction, the displacements, are in fact the numbers of the display units, starting with 00 on the extreme

right hand side.

Because the numbering is right-to-left, incidentally, the first letter to be displayed as the program runs is the last letter of the message. If you want to leave a space, simply load 00 where you want the space; if you want a full stop, use the decimal point, code 80. As usual, the jump instruction (90) at the end of the program causes the program to keep looping round continually, so that the display appears to be static. As before, if you want to get out of it, you have to press reset, and you'll have to load P1 up again one way or another if you want to run it again.

Address	Data	Address	Data
0F20	C4	0F31	39
0F21	33	0F32	C9
0F22	C9	0F33	04
0F23	00	0F34	C4
0F24	C4	0F35	37
0F25	30	0F36	C9
0F26	C9	0F37	05
0F27	01	0F38	C4
0F28	C4	0F39	30
0F29	5F	0F3A	C9
0F2A	C9	0F3B	06
0F2B	02	0F3C	C4
0F2C	C4	0F3D	6D
0F2D	38	0F3E	C9
0F2E	C9	0F3F	07
0F2F	03	0F40	90
0F30	C4	0F41	DE

Fig.5. A very simple message display program.

As a rather primitive method of getting a message over, the program of Fig.5 is acceptable, but it has several drawbacks. One is that the message letters are loaded immediately, they are scattered all the way through the program following each C4 instruction, so that it's not easy to change the message once it's been altered. The other flaw is that the message is static – we can show only as many letters as we have display units for. The first problem we'll deal with now – the second next month.

The load immediate problem has a standard solution, the use of a table. A table is simply a list of data bytes stored together in some part of the memory, with a program which selects whichever byte is wanted. The advantage of using a table for a message display is that we can change the message in the table easily (dial up the starting address, Term, enter, and then use Mem to step through the table), make the message longer or shorter, all without too many alterations to the program. This sort of thing becomes particularly important when long programs are used, as no-one wants to risk scrambling up a long program by putting alterations in, especially if the program has been loaded from tape. Finally, the use of a table lets us write a moving message program, which we'll look at next month, using a technique rather different from the one in the Mk.14 manual.

A Message To You

To work then. Using a table means a very considerable change in the method we've used to program our message. Each byte of the message will now have to be fetched from the memory table, then stored at an LED display unit address, from 0D00 upwards. This is an obvious application for auto-indexing. Remember auto-indexing? You set up a pointer register to an address and then make the address in the register increment or decrement each time you use it. That way, we can dispense with repeating different load instructions. For example, if we store the start of the table of message bytes at address 0F50, we can use an auto-indexed load instruction so that the first time a load is called for, the load is from 0F50, the next time it will be from 0F51, the next time from 0F52 and so on. We can do exactly the same with the LED display unit numbers, auto-indexing the store instruction so that the first store is to 0D00, the next to 0D01, the next to 0D02 and so on. Provided we keep the table in correct order, the right byte is then automatically loaded to the correct unit of the display. This way, the main part of the program needs only one load and one store instruction, each auto-indexed, and we just keep looping round to repeat the performance.

It looks too easy; there must be a snag somewhere! There is, when you think about it. Suppose we have eight bytes in the table, so that we are going to display at eight LED units. Somewhere or other in our program, we are going to have to have some instruction which will detect when eight bytes have been fetched and displayed, because there's no byte in the ninth part of the table (or only gibberish) and no LED after the ninth. To do that, we set up a counter by loading the number 8 into a vacant part of memory and using a B8 instruction. What's a B8? It's decrement and load – the number is decremented by one (8 is reduced to 7, 7 to 6 and so on), then loaded into the accumulator leaving the same decremented number in the memory. We can then use a different jump instruction, JNZ, jump-if-not-zero. If we haven't reached the last LED unit, the program will leap back to load up another data byte and display at another LED unit, but if we've reached the last one the number which is loaded into the accumulator at the decrement-and-load step is zero, and the program won't loop back this time. Just what we want.

Address	Data	Address	Data
0F20	C4	0F2F	C4
0F21	08	0F30	50
0F22	C8	0F31	32
0F23	FC	0F32	90
0F24	C6	0F33	EC
0F25	01	....ABORT.....	
0F26	CD	0F50	33
0F27	01	0F51	30
0F28	B8	0F52	5F
0F29	F6	0F53	38
0F2A	9C	0F54	39
0F2B	F8	0F55	37
0F2C	C4	0F56	30
0F2D	00	0F57	6D
0F2E	31		

To set up: RESET, Address 0FF9, Term : 0D, Mem, 00, Mem, 0F, Mem, 50

Fig.6. A more sophisticated message writer, see text for details.

Next problem. So far, we've loaded each byte from the table to its correct place in the display and, of course, each byte still remains in its place in memory. One run through, however, is too brief to see, a mere phantom flash as it were. We need to keep repeating the performance, looping back right to the start endlessly so that the whole message can be displayed.

As usual, this isn't completely straightforward, because at the end of the program so far as we've taken it, pointer P1 will be set at 0D07 (assuming an eight byte message) and pointer P2 which we're using for the table will

be set at 0F57. These last figures are 7 rather than eight because the first one was 0 rather than one; we started at 0D00 and 0F50, not 0D01 and 0F51. If we simply loop back now, there won't be any display of any byte we want because the starting addresses are wrong. Before we can loop, therefore, we have to correct these starting addresses. This isn't very difficult, because only the lower byte of each has to be changed. For each correction, there's a load-immediate of the lower byte, followed by an XPAL instruction for the pointer register. That's a 00 for P1, with the XPAL code 31, then 50 for P2, with its XPAL code 32. Remember that you have to use different codes when you use different registers. After that it's a matter of looping back to the beginning so that the program can run continuously.

Fig.6 shows the first version of the complete message program. The action starts at 0F20 with a load-immediate of 08. This is for the byte counter – it has to be loaded afresh at the start of each loop, because it is decremented each time a byte is fetched and sent to the display. This number is then stored by the C8 FC instructions into the address 0F1A, one place before the start of the main program. The fetch-and-display routine starts at 0F24, with the auto-indexed load instruction C6, which is relative to pointer P2, the pointer for the table whose starting address is 0F50. The byte following C6 is 01, which specifies that the pointer is to be incremented by 1 *after* each fetch. Note incidentally that incrementing is done after fetching, decrementing before fetching, an invariable rule of auto-indexing. The CD instruction is a store-relative-to-P2, auto indexted, and is also followed by 01, so that this address also increments by one after each fetch. These are the main load and store instructions which get the right bytes to the right display units, then we have the B8 decrement-and-load from address 0F1A, using displacement F6, which checks the number of bytes which have been loaded. This is then followed by JNZ, as described, and then the pointer re-load instructions up to 0F31. Finally, the jump instruction at 0F32, displacement EC, starts the whole program over again at 0F20.

The routine for using this program is to reset, key in 0FF9, Term, 0D (to set pointer P1), then Mem twice to 0FFB to set 0F, then 0FFC to set 50. Then Abort, address 0F20, Term, and start writing the program. After 0F33, Abort, address 0F50, and Term to key in the first message byte. Step through, using Mem, then Abort, and address 0F20. Remember not to use RESET, otherwise you'll lose the pointer addresses. At 0F20, finally, press GO and watch that famous name light up!

Home Try

Now for your homework. First of all, how about loading 0F into the upper byte of P2 at the end of the program and 0D into the upper byte of P1? This lets you start right away after resetting. Secondly, because the program is an endless loop, you can start anywhere provided the first byte of the program is an instruction which can be carried out (you can't start from a data byte, of course). With that in mind, what about starting the program with the pointer load instructions?

Now that you can start up the program so much more easily, you can write your own message. Keep it polite!

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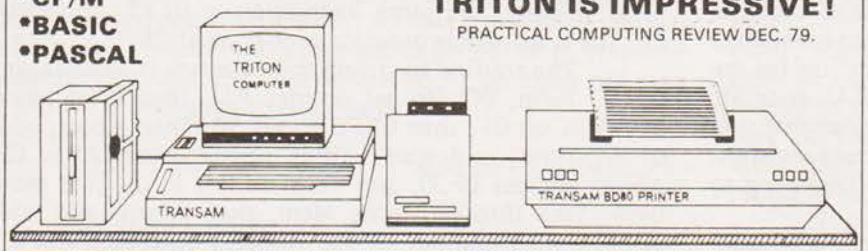

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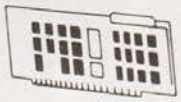

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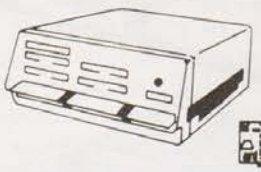

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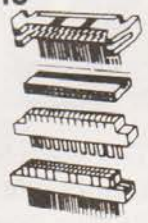

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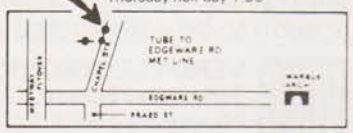

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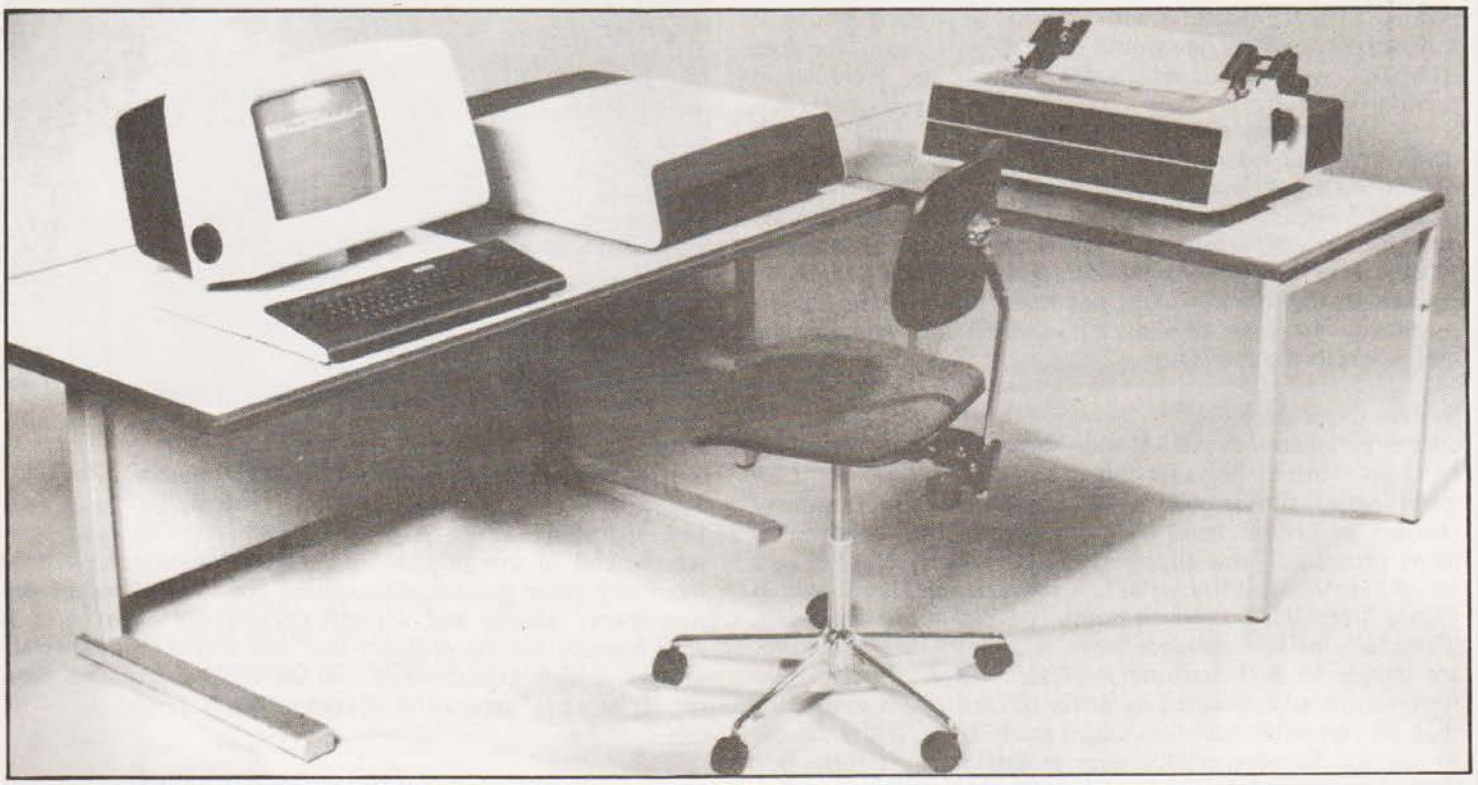
ADAM REVIEW

P.D. Reynolds



Adam may have wandered round the garden of Eden but this particular ADAM is a high powered business system. What can it do? Read on!

Adam our forebear was reputedly a very open person yet to ADAM the computer there is rather more than meets the eye. ADAM looks like a particularly neat but otherwise conventional one-person computer system, with the usual television-type screen and keyboard, with a printer. There is also a disk unit with one fixed and one removable cartridge, each with a 5.2MB capacity.

A 'physical key' is required to turn on the mains switch, like the ignition in a car. Once the power is on the screen immediately tells you what to do next, step by step. Top of the list is to ensure that the removable 5 megabyte disc you will be using is safely duplicated on a fixed disc of similar capacity in the machine. Normally you will "copy down" earlier work from a removable disc you have brought to the machine but sometimes you may want to "copy up" work onto an empty disc. In allowing this choice, ADAM's series of questions and prompts make it difficult for you to make a mistake. An experienced operator may find the process tedious, though it takes only a very few minutes, but business users will appreciate the value of the almost foolproof discipline.

Teaching ADAM

You are now ready to give ADAM some data to store and to teach it what to do with that data. This does not involve the use of any kind of conventional programming language, only the creation of files and the definition of some "nouns" and "verbs". You might have a file called "customer", holding each customer's reference number followed by his name, address, terms of business etc – not very different from a traditional computer datafile but rather more easy to set up without previous experience. An example of the way a file is set up is shown in Fig.1.

The file structure is established by listing the "nouns" that describe what data the file will contain. Readers used to BASIC and other programming languages can think of nouns as the names of variables (numeric or string, ADAM does not mind) with a permitted length of up to twenty-four characters (eg TOTAL PAY FOR 1978/9).

Verbosity Is The Key

A verb is ADAM's counterpart of a program or subroutine. No prior knowledge of computing is required to write verbs, because ADAM prompts the user at every stage, but it is desirable to know the business you are 'teaching' (rather than 'programming') ADAM to serve. Clerks and secretaries, even business men sometimes, are the kind of people intended to develop ADAM's vocabulary. A logical mind is an asset in anyone teaching this Logical Machine (as the makers prefer to call it, rather than 'computer') but actual programming experience in the usual languages can be a slight disadvantage if it leads to expecting to encounter rules and disciplines which ADAM certainly has but conceals from the user. Fig.2 illustrates the way a verb is defined. Notice that it acts on nouns and may incorporate the use of other verbs, each of which will have to be separately defined elsewhere.

ADAM's verbs are rather like structured programming, but easier for someone else to follow. Users are encouraged to keep their verbs relatively short (say from ten to twenty lines) and experience with a large application shows that this, more than any other controllable factor, speeds up data processing significantly.

A minor feature that BASIC-trained programmers will appreciate is that when a new line is added to a verb any required renumbering of lines is taken care of automatically.

Another friendly touch is that numbers are normally

printed (if space permits) with commas separating groups of three digits – just as one would write or type them. Nor does it matter whether or not such numbers are included in numeric input.

ADAM has a permanent repertoire of some 50 standard verbs and nouns, listed in Table 1, on which all user definitions are ultimately based. Readers of PCW might think of the 50 words as analogues to the instruction set associated with every CPU chip, but John Peers (who 'conceived' ADAM in England before deciding that it could only be realised in California) would not thank anyone who sought to destroy the image of a black box which does whatever the user wants in the user's way.

System Experience

User experience with ADAM soon showed that large numbers of them wanted the same things and to avoid constant re-invention of similar wheels the Logical Machine Company (known as Lomac before a prior user of that abbreviated name protested) now supplies, and is regularly extending, a set of "standard utility verbs". A few examples are shown in Figure 3 but the list, which numbered 219 at my last count, is regularly being extended. While many of ADAM's features are unique to that machine the disemination of useful sub-routines (mostly designed by or for other users) is something that all computer suppliers could easily copy, if they chose to do so. Some specialist user groups attempt this, in a limited way, but I do not know of a single machine manufacturer other than the Logical Machine Company who demonstrates comparable unmercenary interest in their users' wellbeing.

It is easy to get ADAM to do useful work but it is also tedious. A first-time users of a computer and sets out to be easy and friendly and liberated from dependence on specialists. A long delay between delivery of a machine and its beginning to do useful work is far from friendly so, to reduce the learning time, the Logical Machine Company now provides ADAM users with a set of skeletal models for some of the most commonly encountered applications. Naturally, these models are self documenting and it is easy for users to alter them. Indeed, they are encouraged to do so (see extract from the supplier's literature in Fig.4 to produce systems which exactly suit the needs of each individual business, which is much better than forcing the business to fit the mould of a "standard package". Fig.5 itemises these skeletal models, all of ADAM currently costs £17,500 in the UK. The small capacity Tina is currently priced at £11,500 for any one basic version. Several hundreds are in use in the USA through the Cheltenham and Manchester Business Centres of Beam Office Equipment Ltd (061-831-7292).

"What about file handling?" asked a friend. "Surely you need some disciplined procedure to open and close data files for reading and writing?" Of course you do, but the ADAM user is left unaware of it. ADAM has a very complete and meticulous monitor which takes care of all those details, indeed which would seem by some standards to be extravagant in its endeavour to make the machine foolproof and easy to recover from the results of any operator error.

Great care is also taken against hardware failures. The mains supply is not expected to be clean, so it is adequately regulated and protected – other manufacturers please copy! ADAM it is said to be unaffected by a supply voltage reduction of as much as 19% and in the event of complete power failure standby batteries are switched in automatically to maintain the otherwise volatile memory. When power is restored (within four hours) the user just carries on from the point of interruption, with no special

re-start procedures required for ADAM to operate.

In Conclusion

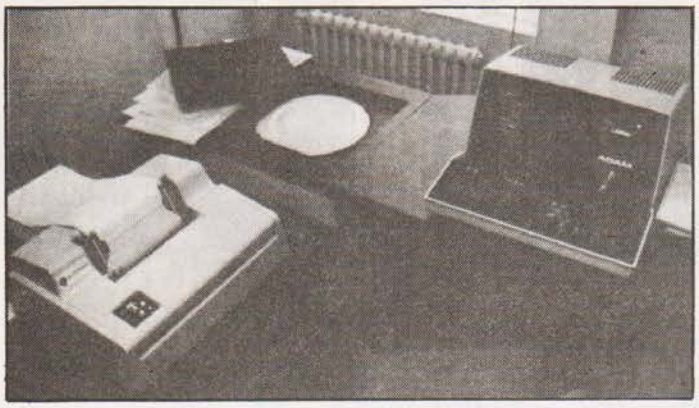
At the end of the day ADAM's output looks very like that from any other good-quality system but the method of getting there, reliably and without dependence on experts, is very friendly for the ordinary user and it is this "de-specialisation" which characterises ADAM as the probable forerunner of a new generation of computers.

```
RECAP
EMPLOYEE NAMES  is a file,
   1 Uses  COMMENT
     The REFerence to this file will be the contents of
   2 and  COMMENT
            the noun EMPLOYEE NAME
   3 and  EMPLOYEE NAME
   4 and  EMPLOYEE NO
```

Fig.1. Creating a file. This unusually short example from a payroll suite exists to allow indexing by employee name. The 'Employees' file, indexed by employee number, uses 35 nouns. The COMMENT lines, like REMARK in BASIC, have no effect in processing.

```
RECAP
PR MENU   is a verb,
   1 Does  CLEAR SCREEN
   2 and  DCENTER     "PAYROLL"
   3 and  MOVE     0     MENU NUMBER
   4 and  DISPLAY LINE FEED
   5 and  DISPLAY LINE FEED
   6 and  MENU DISPLAY "ADD NEW EMPLOYEES"
   7 and  MENU DISPLAY "EMPLOYEE RECORD MAINTenance"
   8 and  MENU DISPLAY "ENTER CURRENT PAY INFOrmation"
   9 and  MENU DISPLAY "PRINT PAYROLL REGISTER"
  10 and  MENU DISPLAY "PRINT PAYROLL CHECKS"
  11 and  MENU DISPLAY "TERMINATE AN EMPLOYEE"
  12 and  MENU DISPLAY "EMPLOYEE INQUIRY"
  13 and  SELECT PR TASK
  14 and  IF     PAYROLL SELECTION     ^     "END"
       do  REPEAT

RECAP
SELECT PR TASK   is a verb,
   1 Does  DISPLAY LINE FEED
   2 and  !MESSAGE "Select by number(or END if no more)"
   3 and  INPUT     3     PAYROLL SELECTION
```



```
 4  and  IF     PAYROLL SELECTION     =     "END"
      do  CONTINUE
 5  and  IF     PAYROLL SELECTION     =     1
      do  ADD NEW EMPLOYEES
 6  and  IF     PAYROLL SELECTION     =     2
      do  EMPLOYEE RECORD MAINT
 7  and  IF     PAYROLL SELECTION     =     3
      do  ENTER CURRENT PAY INFO
 8  and  IF     PAYROLL SELECTION     =     4
      do  PRINT PAYROLL REGISTER
 9  and  IF     PAYROLL SELECTION     =     5
      do  PRINT PAYROLL CHECKS
10  and  IF     PAYROLL SELECTION     =     6
      do  TERMINATE AN EMPLOYEE
11  and  IF     PAYROLL SELECTION     =     7
      do  EMPLOYEE INQUIRY
```

Fig.2. Use of typical VERBS in a payroll system. Each verb is typically a sequence of other verbs which will have been built up individually from Adam's basic repertoire of 50 odd words. The second verb listed above features as item 13 in the first verb. It makes for faster operating to have a larger number of short verbs instead of fewer but longer ones.

STANDARD NOUNS

The following table lists the standard Nouns and their abbreviations. Note that there are no abbreviations for the Nouns OBJECT and REF.

NOUN	ABBREV
DIF	DF
FRAC	FC
HEAD	HD
INTG	NT
LENGTH	LT
OBJECT	
PROD	PD
QUOT	QT
REF	
SUM	SM
TAIL	TL

STANDARD VERBS

The following table lists the standard Verbs and their abbreviations.

VERB	ABBREV
ADD	+
ALTER	AL
BEGIN	BG
COMMENT	CM
CONTINUE	CN
CUT	CT
DELETE	DL
DISPLAY	DS
DIVIDE	/
EXCHANGE	XC
EXCHANGE ALL	XA
FILE	FL
FIX	FX
FORGET	FG
GET	GT
GO TO	GO
IF	IF
IF REF	IR
INPUT	IN
$INPUT	$N
JOIN	JN
LABEL	LB
LIST FILES	LF
LIST NOUNS	LN
LIST REFS	LR
LIST UNDEF	LU
LIST VERBS	LV
MOVE	MV
MULTIPLY	*
OUTPUT	OT
PRINT	PR
RECAP	RC
RECAP ALL	RA
RENAME	RN
REPEAT	RP
SAVE	SV
SPLIT	SP
START	ST
STATUS	
SUBTRACT	–
TRACE	TR
VERB	VB

Table 1 Standard Nouns and Verbs

BIG CHARS
BREAK AT (asterisk, hyphen, etc)
CENTER
CLEAR SCREEN
CONVERT TO WORDS
CURSOR (up, down, etc)
ENTER A Y OR N
PAD (leading zeros, trailing spaces)
REMOVE LEADING ZEROS
ROUND TO (n decimals, etc)
SLOW DOWN SCREEN

Fig.3. Examples of Standard Utilities. A utility is just a verb that is useful in a number of contexts. Most users will define a few for their own particular situations, but Standard Utilities, like those illustrated above, are shared because they are seen to interest several users. This selection came from a list of 219.

ADAM has been taught the ACCOUNTS RECEIVABLE with INVENTORY CONTROL model so that he can learn your job a little faster –– like a trade school graduate. He, by no means, knows all there is to know about Accounts Receivable with Inventory Control. But he has been taught the basics. Now you will need to train him in the specifics about

your Accounts Receivable and Inventory Control.

Let us begin with an overview of the things ADAM knows about Accounts Receivable and Inventory from his basic training.

1. ADD NEW CUSTOMERS to his Accounts Receivable

When you sell something to a new customer, one of the first things that must be done is to inform the Accounts Receivable Clerk. The Accounts Receivable Clerk will need to know such things as the customer's name, address, city, state, zip code, and the customer number assigned to them.

There are other things which your Accounts Receivable Clerk might want, but which you will need to teach ADAM. Examples would be "ship to" information for customer name, address, city, state, and zip code; customer telephone number, accounting contact person, credit limit, whether or not the customer accepts back-orders, etc.

Also, when your company sells to a new customer, their account balance will be zero, and there will be no open invoices for this new customer.

Should your business require it, you may need to teach ADAM about such things as date of last payment, last payment amount, a payment code to indicate if the customer pays on time, a little slow, very slow, etc.; discount terms, and so forth.

Fig.4. Part of the supplier's description of a skeletal model.

Accounts Receivable with Inventory Control

- Add new customers
- Customer record maintenance
- Add new inventory item
- Inventory item maintenance
- Enter invoicing information
- Print invoices
- Print sales journal
- Customer payment journal
- Aged analysis (of trade debts)
- Print customer statements
- Delinquency notices (reminders of unpaid bills)

Accounts Payable

- Add new vendors (= suppliers)
- Vendor record maintenance
- Post vendor invoices (= enter purchase ledger)
- Print invoice input list (= purchase day book)
- Print cash requirements (based on invoice data)
- Print vendor cheques
- Vendor cheque register (= purchases cash book)

Payroll (9 elements)

General Ledger (8 elements)

Figure 5. Skeletal Models for users

YOUR COMPANY NAME

Balance Sheet, MARCH 31, 1978

ASSETS

Current Assets	
Cash	$ 1,050.00
Notes Receivable	300.00
Accounts Receivable	4,941.00
Merchandise Inventory	12,744.00
Prepaid Insurance	1,109.00
Office Supplies	44.00
Stores Supplies	145.00
Total Current Assets	$ 20,357.00
Fixed Assets	
Office Equipment	$ 1,500.00
Less: Accumulated Depreciation	-300.00
Store Equipment	9,200.00
Less: Accumulated Depreciation	-800.00
Buildings	25,000.00
Less: Accumulated Depreciation	-7,400.00
Land	4,200.00
Total Fixed Assets	25,400.00
Total Assets	$ 45,757.00

LIABILITIES

Current Liabilities	
Notes Payable	$ 3,000.00
Accounts Payable	$ 6,213.00
Accrued Wages Payable	$ 112.00
Total Current Liabilities	$ 9,325.00
Long-Term Liabilities:	
First Mortgage, Buildings	$ 8,000.00
First Mortgage, Land	$ 2,000.00
Total Long-term Liabilities	10,000.00
Total Liabilities	$ 19,325.00

CAPITAL

Samuel Jackson, Equity	$ 11,860.50
Robert Jackson, Equity	$ 11,860.50
Net Operating Profit	2,711.00
Total Capital	26,432.00
Total Liabilities & Capital	$ 45,757.00

Figure 6. Example of Output from a Skeletal Model

Central Processor – 16 bit, 170 nanosecond cycle time, built up from Intel 3002 bipolar 2-bit slices.

Memory Processor – 32K bytes plus optional 32K bytes extra. *All* memory is used or controlled by the operating system; the user effectively works from the disc.

Control memory – 512 32-bit words.

Registers – 10 16-bit control registers
16 16-bit general purpose registers.

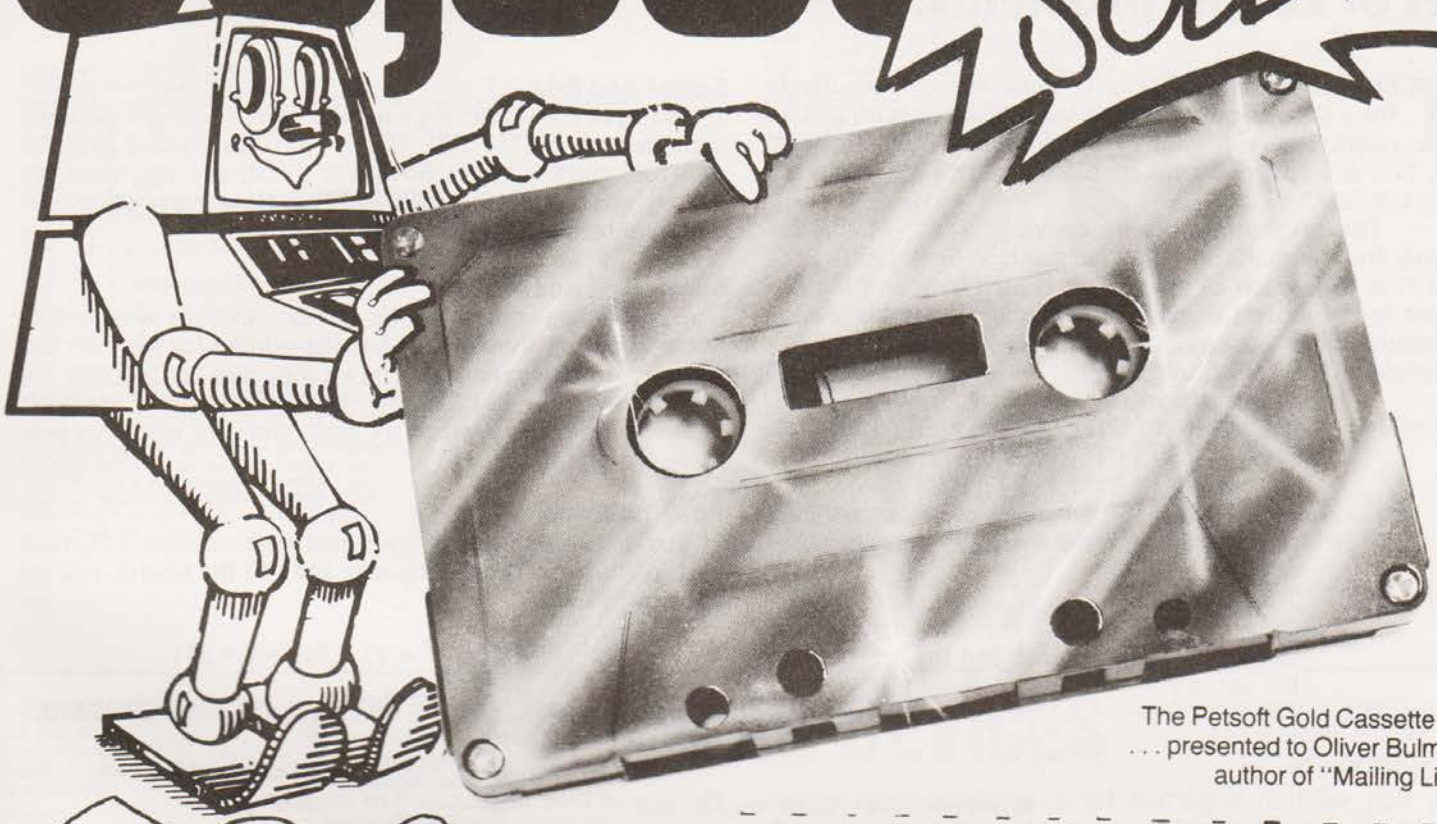
Input/Output controllers – None required. The fast CPU has time available to emulate the I/O controller functions and is directly connected to all I/O devices.

Disc drive – Control Data model 9472H with one fixed and one removable disc, each of 5.3 megabyte capacity. Data transfer rate 1.25 megabytes per second.

Data code – ASCII

Table 2. Some vital statistics. The manufacturers do not disclose this sort of information directly (arguing that their kind of user cannot use it and should not want it). The details above have been gleaned from a report published by Datapro.

50,000TH PROGRAM SOLD!



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I live at _____

_____ Postcode _____

I have a new/old ROM PET I have NO PET

Trevor Lusty

The solution to the format problem may not be as easy as you thought but Trevor Lusty gives his version along with a set of simple problems.

The first solution (Figure 1) shows a program suitable for a shopkeeper offering variable discounts on certain items. For each value P, read from a DATA statement, 7%, 11% and 13% discounts are calculated and the results are then tabulated.

The program works by converting each of the discounts from numeric to string constants in lines 240 to 260. The first .5 in each of these lines is used to round the discount to the nearest number of pence, the second is present to ensure that trailing zeros are printed.

Example :– 7% discount on £15–60 means you pay 93% of this amount.

in line 240 X$ = STR$ ((INT(15.6*93 + .5) / 100)
= STR$ ((INT(1450.8 + .5) + .5) / 100)
= STR$ ((1451 + .5) / 100)
= "b14.515" where b indicates the blank space reserved for the sign if the number is negative.

in line 270 X1 = LEN(X$) – 1
= 7 – 1 = 6 note that the length of the string includes the space and the position for the decimal point.

in line 300 "b14.51" is printed starting in column 14.

Solution Two

The first solution is perfect for a dedicated program but would require rewriting for any subsequent programs. A better solution may be achieved by using a subroutine. This may then be incorporated into any new program without alteration. To be as general as possible the subroutine should handle words as well as numbers and the solution given (Figure 2) does this.

The subroutine has line numbers from 9000 to 9960 and these line numbers should be avoided in your program. Lines 1000 to 1200 show how the subroutine may be called. The required format for the print statement is set up in the string variable F$, with *'s in the places where the numbers will be. The numbers to be printed are put into array N; if there are more than ten numbers to be printed in any one line then N must be suitably dimensioned.

Variables used in the subroutine must not be used in the main program, and for this reason all simple variables used end with a 9. (A9, B9 etc.) Apart from these, the only variables to be avoided are the string variables N$ and F$ and the array variable N.

The subroutine is useful if your BASIC does not have a PRINT USING statement. However, when using the subroutine, there is a small penalty to pay in processing time. The format F$ need not be set up every time the subroutine is called but only requires altering when the desired layout changes.

A Pot Pourri Of Problems

The last couple of months' problems have been fairly long so, by way of a change, here's a selection of short problems for you to try.

Square And Add – 1

If you square the four digit number 7,777 you get the eight digit number 60,481,729. If you split this number into the two four digit numbers 6048 and 1729, and add them together, you get 6048 + 1729 = 7777. How many other four digit numbers can you find with this property?

Square And Add – 2

Now, providing your computer works with eight or nine digit arithmetic, you should have had little difficulty with the last problem, so let's extend it. The six digit number 356,643 has the square 127,194,229,449 and 127194 + 229449 = 356643. How many other six digit numbers with this property can you find?

Powerful Digits

If you take the digits of the three digit number 371, raise each of them to the third power and add the results, you get back to 371.

$$3^3 + 7^3 + 1^3 = 27 + 343 + 1 = 371$$

How many other three digit numbers can you find with this property?

How many five digit numbers can you find which are the sum of their digits raised to the fifth power?

```
100 REM ****************
110 REM *                *
120 REM * MAKING PENCE   *
130 REM *                *
140 REM * SOLUTION FOR   *
150 REM * PROBLEM NO.5   *
160 REM *                *
170 REM ****************
180 PRINT
190 PRINT "    RIGHT      7 %      11 %      13 %"
195 PRINT "    PRICE     DISC.     DISC.     DISC."
200 PRINT "    =====     =====     =====     ====="
210 PRINT
220 READ P
230 IF P<=0 THEN 350
235 P$=STR$((INT(P*100+.5)+.5)/100)
240 X$=STR$((INT(P*93+.5)+.5)/100)
250 Y$=STR$((INT(P*89+.5)+.5)/100)
260 Z$=STR$((INT(P*87+.5)+.5)/100)
265 P1=LEN(P$)-1
270 X1=LEN(X$)-1
280 Y1=LEN(Y$)-1
290 Z1=LEN(Z$)-1
295 PRINT TAB(9-P1);LEFT$(P$,P1);
300 PRINT TAB(19-X1);LEFT$(X$,X1);
310 PRINT TAB(29-Y1);LEFT$(Y$,Y1);
320 PRINT TAB(39-Z1);LEFT$(Z$,Z1)
330 GOTO 220
340 DATA 100,15.6,190,1000,123.5,0
350 PRINT
360 PRINT
370 END
READY.
```

Fig.1a. The program listing for a typical use of the format solution.

PROBLEM PAGE

```
  RIGHT       7 %         11 %        13 %
  PRICE       DISC.       DISC.       DISC.
  =====       =====       =====       =====

 100.00       93.00       89.00       87.00
  15.60       14.51       13.88       13.57
 190.00      176.70      169.10      165.30
1000.00      930.00      890.00      870.00
 123.50      114.86      109.92      107.45
```

Fig.1b. A set of results produced by the program.

```
1000 LET N(1)=-123.456
1020 LET N(2)=N(1)
1040 LET F$="THE FORMAT MAY CONTAIN WORDS AND NUMBERS ****.***"
1060 GOSUB 9000
1080 LET F$="THE ROUTINE ROUNDS -***.*** TO -***.**"
1100 GOSUB 9000
1120 LET F$="THE ROUTINE WILL PRINT WITH **** OR WITHOUT *** THE SIGN"
1140 GOSUB 9000
1160 LET F$="IF YOU DO NOT ALLOW ENOUGH SPACE *** PRINTS AS **"
1180 GOSUB 9000
1200 END
9000 REM *******************************
9020 REM *                             *
9040 REM * SUBROUTINE TO FORMAT OUTPUT *
9060 REM *                             *
9080 REM * RML 9K DISC BASIC VER 3.0B  *
9100 REM *                             *
9120 REM * TREVOR LUSTY   20TH OCT 79. *
9140 REM *                             *
9160 REM *******************************
9180 T9=0:D9=1:C9=1:N$="0123456789"
9200 B9=1:S9=1:F9=1:N9=1:A9=1:W9=2:P9=C9-1:T9=T9+1
9220 P9=P9+1
9240 IF P9=LEN(F$)+1 THEN PRINT:RETURN
9260 IF MID$(F$,P9,1)="*" THEN 9360
9280 IF MID$(F$,P9,2)=".*" THEN 9360
9300 IF MID$(F$,P9,2)="**" THEN 9340
9320 PRINT MID$(F$,P9,1);:GOTO 9220
9340 S9=0:GOTO 9220
9360 I9=100:N9=N(T9):C9=P9-1
9380 C9=C9+1
9400 IF MID$(F$,C9,1)="*" THEN 9380
9420 IF MID$(F$,C9,1)<>"." THEN 9480
9440 IF F9<>1 THEN 9480
9460 F9=0:I9=C9:W9=0:GOTO 9380
9480 IF I9<>100 THEN 9520
9500 I9=C9
9520 IF S9=1 THEN 9600
9540 IF N9 >= 0 THEN 9580
9560 PRINT "-";:GOTO 9600
9580 PRINT " ";
9600 N9=ABS(N9)+10↑(I9-C9-1)
9620 V9=10↑(I9-P9):X9=I9+1-C9
9640 Y9=10↑(X9-2-W9):Z9=10↑(W9-X9)
9660 FOR J9=I9-P9 TO X9 STEP -1
9680 IF MID$(F$,I9-J9,1)<>"." THEN 9720
9700 PRINT ".";:B9=0:A9=2:GOTO 9940
9720 D9=INT((N9+Y9)/10↑(J9+A9-2))
9740 IF N9<V9 THEN 9780
9760 PRINT "*";:GOTO 9940
9780 N9=INT((N9-D9*10↑(J9+A9-2))*Z9+.5)/Z9
9800 IF D9=0 THEN 9840
9820 B9=0
9840 IF B9=0 THEN 9920
9860 IF J9<>1 THEN 9900
9880 PRINT "0";:GOTO 9940
9900 PRINT " ";:GOTO 9940
9920 PRINT MID$(N$,D9+1,1);
9940 NEXT J9
9960 GOTO 9220
```

```
THE FORMAT MAY CONTAIN WORDS AND NUMBERS -123.456
THE ROUTINE ROUNDS -123.456 TO -123.46
THE ROUTINE WILL PRINT WITH -123 OR WITHOUT 123 THE SIGN
IF YOU DO NOT ALLOW ENOUGH SPACE 123 PRINTS AS **

>READY
```

Fig.2. The formatting subroutine that can handle both alpha and numeric characters. The workings are explained in the text.

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6502 microprocessor
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16-way I/O with 128 bytes of RAM
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5 V regulator, sockets for 2K EPROM and second RAM I/O chip.
2. Keyboard card
25 click-keys (16 hex, 9 control)
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Stepping up through memory
Stepping down through memory
Set or clear break point
Restore from break
Load from tape
Store on tape
Go (recalls last address used)
Reset
Monitor features
System program
Set of sub-routines for use in programming
Powerful de-bugging facility displays all internal registers
Tape load and store routines

Applications
As a self teaching tool for beginners to computing.
As a low cost 6502 development system for industry.
As a basis for a powerful microcomputer in its expanded form.
As a control system for electronics engineers.
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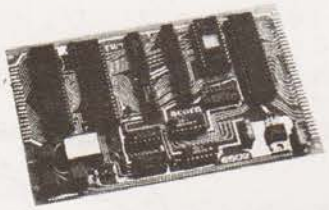
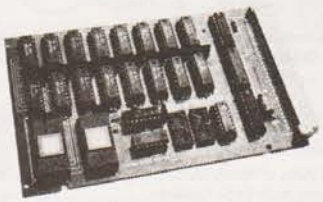


Acorn Controller
£35 plus VAT (min config.)

the CPU card of System 1, it allows for up to 4½ k EPROM, 1¼ k RAM and 32 I/O lines. It has on board 5 V regulator and optional crystal control. Custom programs may be developed on System 1 and the card makes an ideal dedicated hardware module.



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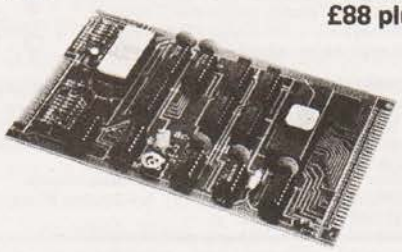

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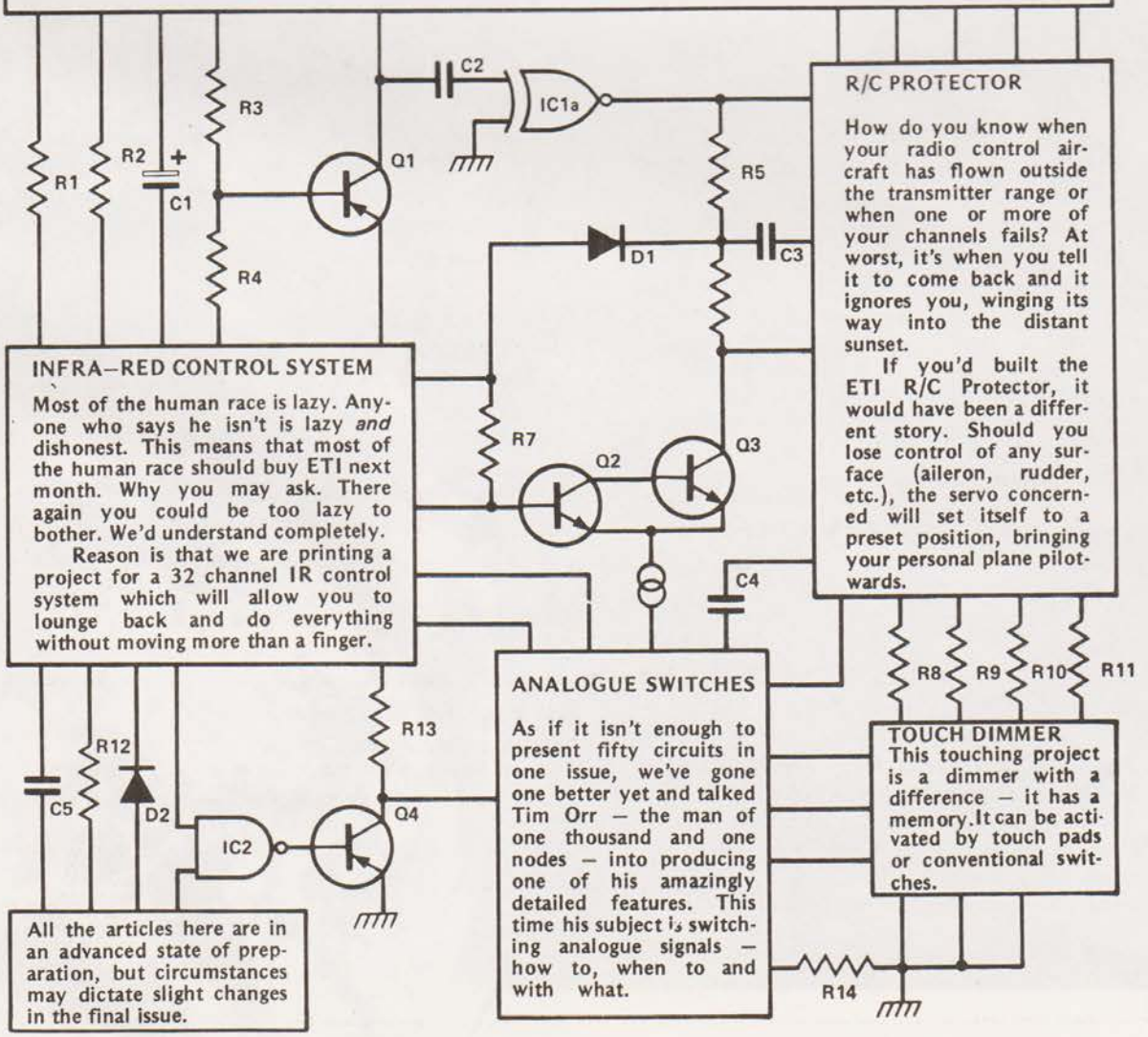
50 TESTED CIRCUITS TO BUILD



INFRA–RED CONTROL SYSTEM

Most of the human race is lazy. Anyone who says he isn't is lazy *and* dishonest. This means that most of the human race should buy ETI next month. Why you may ask. There again you could be too lazy to bother. We'd understand completely.

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R/C PROTECTOR

How do you know when your radio control aircraft has flown outside the transmitter range or when one or more of your channels fails? At worst, it's when you tell it to come back and it ignores you, winging its way into the distant sunset.

If you'd built the ETI R/C Protector, it would have been a different story. Should you lose control of any surface (aileron, rudder, etc.), the servo concerned will set itself to a preset position, bringing your personal plane pilotwards.

ANALOGUE SWITCHES

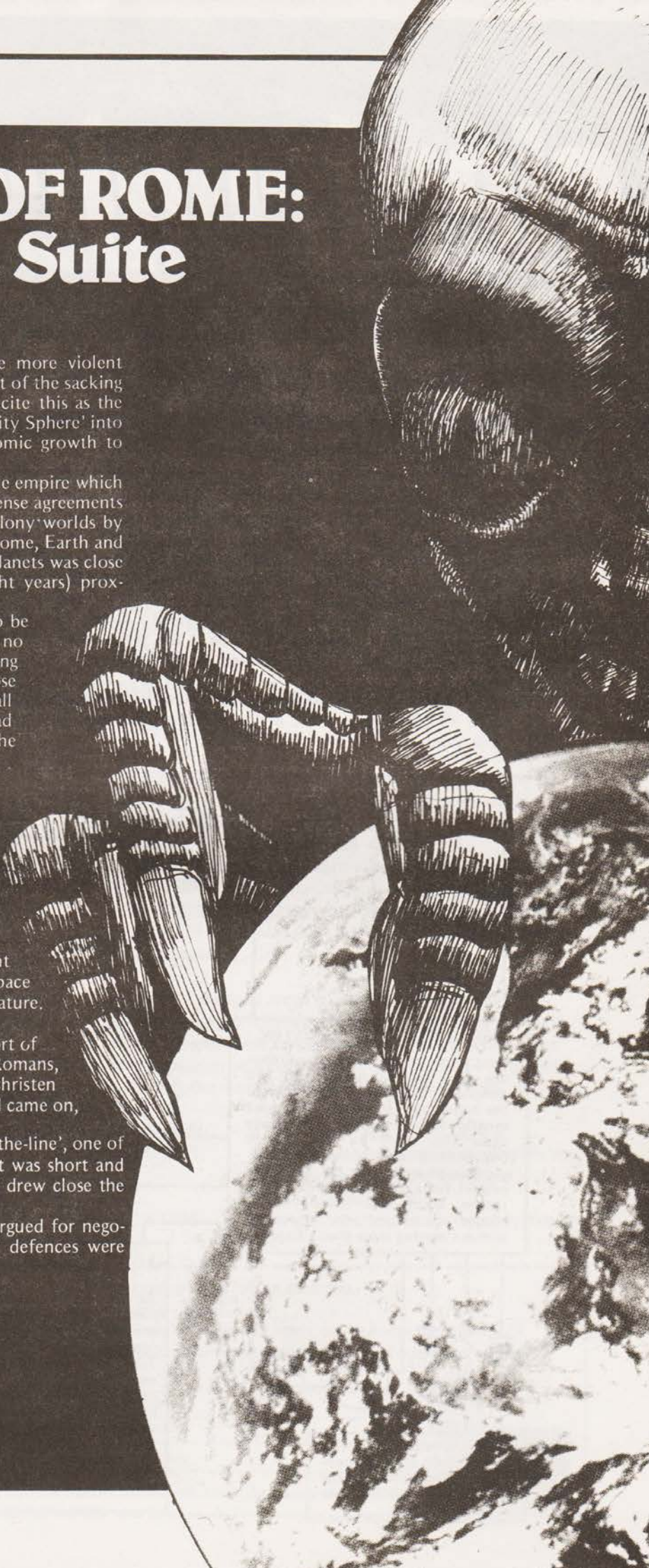
As if it isn't enough to present fifty circuits in one issue, we've gone one better yet and talked Tim Orr – the man of one thousand and one nodes – into producing one of his amazingly detailed features. This time his subject is switching analogue signals – how to, when to and with what.

TOUCH DIMMER

This touching project is a dimmer with a difference – it has a memory. It can be activated by touch pads or conventional switches.

All the articles here are in an advanced state of preparation, but circumstances may dictate slight changes in the final issue.

THE FALL OF ROME: A Program Suite



This program set simulates one of the more violent episodes in early Terran expansion; that of the sacking of the planet Rome. Some historians cite this as the incident which finally brought the 'Coprosperity Sphere' into a state of cohesion and thus allowed economic growth to take place on hitherto impossible scale.

Rome itself lay outside the loose trade empire which existed at that time and had no reciprical defense agreements at all, save that unilaterally granted to all colony worlds by Earth itself. Due to the relative positons of Rome, Earth and the Travel Points, transit time between the planets was close to 100 hours despite the relative (27 light years) proximity.

Help from home was thus destined to be a little late in arriving. New worlds were in no position to offer assistance in any event, tending to husband any forces they possessed in close orbit to be committed — uselessly — in small numbers later. The idea of a united fleet had met with indecisive suspicion many times in the preceeding years.

First Signs

The approach of the alien fleet was noted by deep space radar operators throughout the sector. On Rome itself the rooms containing the equipment filled rapidly with the news of unknown ships pouring out of the Points in apparently large numbers.

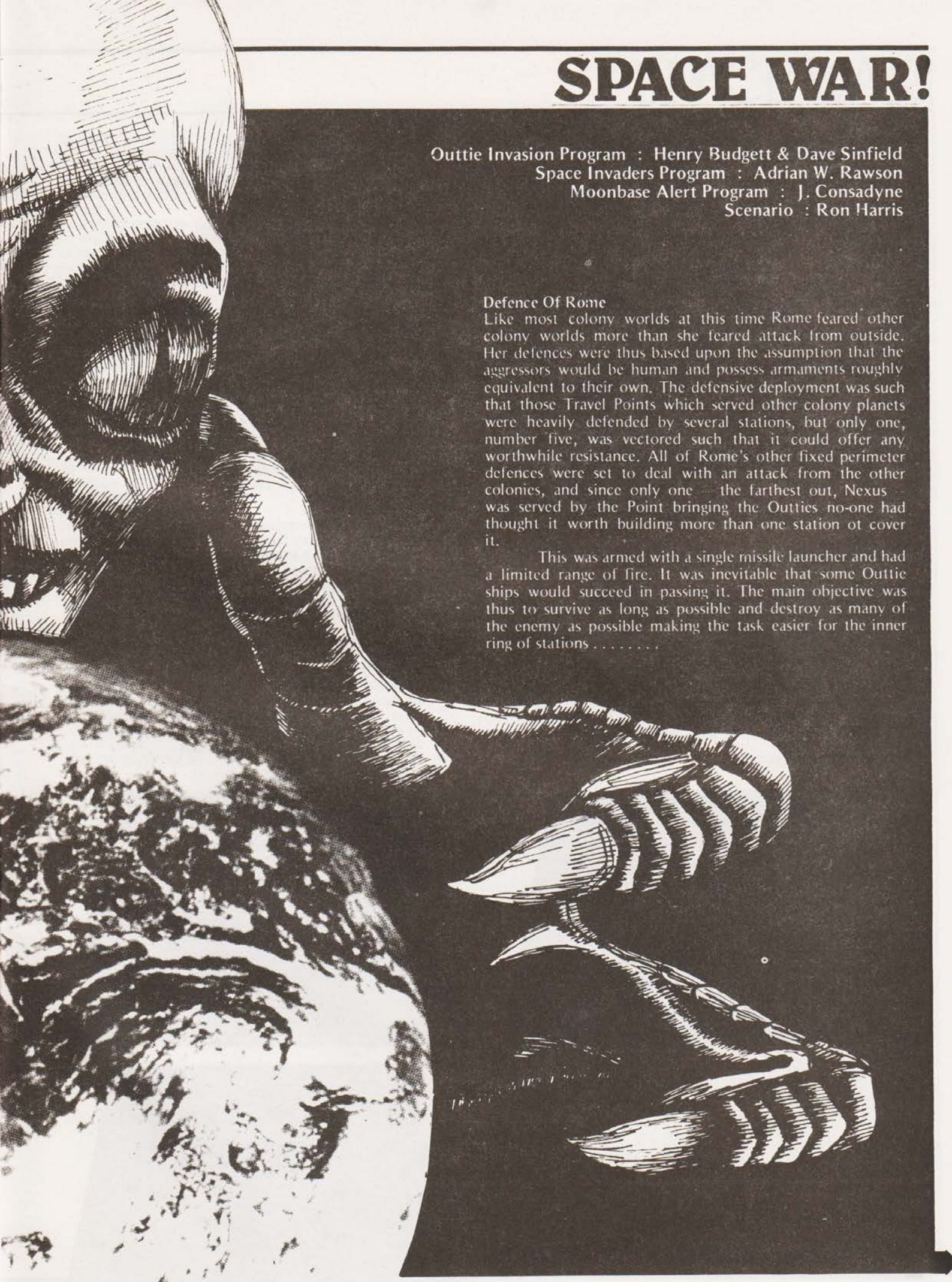
The angle of exit from the Travel Point indicated that the craft had entered hyper-space outside known space and were thus alien in nature. Outsiders had arrived at last.

The fleet did not form up into any sort of order that was detectable to the watching Romans, the 'Outties' — as the news media came to christen them — simply massed the ships together and came on, straight at Rome.

First contact was made by a 'ship-of-the-line', one of Rome's four first class warships. The contact was short and to the point. As soon as the ship 'Claudius' drew close the Outties blew it to pieces.

At that point the faction who had argued for negotiation began to lose a little credibility and defences were readied.

SPACE WAR!



Outtie Invasion Program : Henry Budgett & Dave Sinfield
Space Invaders Program : Adrian W. Rawson
Moonbase Alert Program : J. Consadyne
Scenario : Ron Harris

Defence Of Rome

Like most colony worlds at this time Rome feared other colony worlds more than she feared attack from outside. Her defences were thus based upon the assumption that the aggressors would be human and possess armaments roughly equivalent to their own. The defensive deployment was such that those Travel Points which served other colony planets were heavily defended by several stations, but only one, number five, was vectored such that it could offer any worthwhile resistance. All of Rome's other fixed perimeter defences were set to deal with an attack from the other colonies, and since only one — the farthest out, Nexus — was served by the Point bringing the Outties no-one had thought it worth building more than one station ot cover it.

This was armed with a single missile launcher and had a limited range of fire. It was inevitable that some Outtie ships would succeed in passing it. The main objective was thus to survive as long as possible and destroy as many of the enemy as possible making the task easier for the inner ring of stations . . . . . .

Outtie Invasion

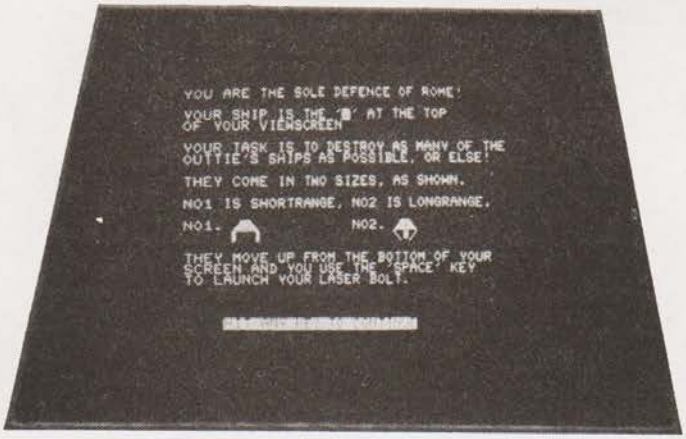
Program Notes

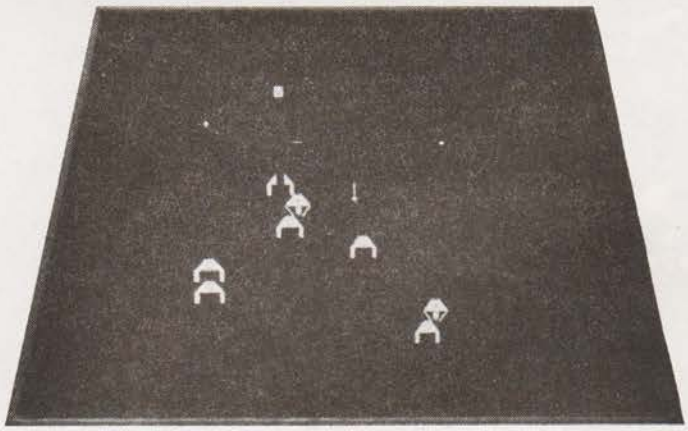
Because our line printer can't handle graphics the following points should be borne in mind when loading or modifying this program. The ships are generated with the following graphics; Shortrange – REV SHIFT), REV SHIFT W, REV SHIFT , CURSOR DOWN, 3 CURSOR LEFT, SHIFT 5, SPACE, SHIFT 6 Longrange – REV SHIFT), REV SHIFT [, REV SHIFT , CURSOR DOWN, 3 CURSOR LEFT, SHIFTM, ASTERISK, SHIFT N. The defender is generated with a reverse V character. The codes are PRINTED not POKED for the Outties so the PEEK codes are needed to check for hits or near misses.

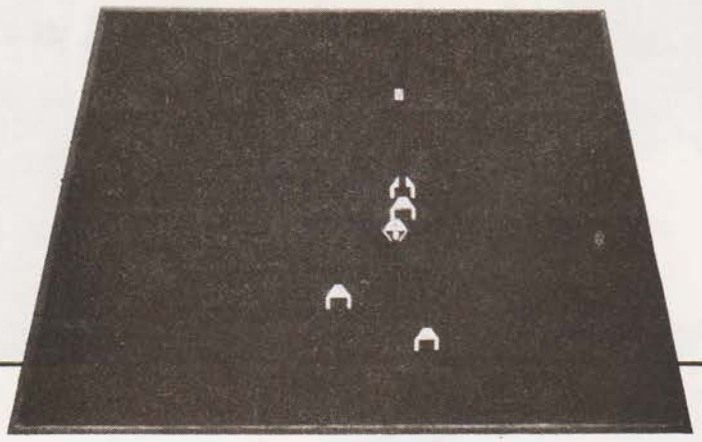
Some of the text is printed in reverse field, this occurs in lines 250, 330, 340 and can be identified by the 2 after the last text character. Code 3 at the beginning of a text string indicates clear screen. A variable list is printed at the end of the listing for general deciphering of the program.

READY.

```
100 PRINT"3":PRINT"?   DO YOU NEED INSTRUCTIONS, Y OR N?
110 GET A$:IF A$="" THEN 110
120 IF A$="N" THEN 370
130 PRINT"3 YOU ARE THE SOLE DEFENCE OF ROME!
140 PRINT
150 PRINT" YOUR SHIP IS THE 'V2' AT THE TOP
160 PRINT" OF YOUR VIEWSCREEN":PRINT
170 PRINT" YOUR TASK IS TO DESTROY AS MANY OF THE
180 PRINT" OUTTIE'S SHIPS AS POSSIBLE, OR ELSE!
190 PRINT:PRINT" THEY COME IN TWO SIZES, AS SHOWN.
200 PRINT:PRINT" NO1 IS SHORTRANGE, NO2 IS LONGRANGE.
210 PRINT:PRINT" NO1. )w2===5 61          NO2. )(2===■*n
220 PRINT:PRINT" THEY MOVE UP FROM THE BOTTOM OF YOUR
230 PRINT" SCREEN AND YOU USE THE 'SPACE' KEY
240 PRINT" TO LAUNCH YOUR LASER BOLT.
250 PRINT:PRINT:PRINT:PRINT"    HIT ANY KEY TO CONTINUE2
260 GETA$:IFA$="" THEN 260
270 PRINT"3":PRINT:PRINT:PRINT:PRINT:PRINT"IF YOU DO NOT SCORE A DIRECT HIT YOU
280 PRINT" WILL NOT DESTROY THE OUTTIE.
290 PRINT:PRINT" YOU CAN CHANGE THE DIRECTION THAT YOU
300 PRINT" ARE MOVING IN WITH THE 'R' KEY.
310 PRINT:PRINT" REMEMBER THAT THE OUTTIES SPEED UP
320 PRINT" THE MORE YOU SHOOT THEM DOWN AND
330 PRINT" WHEN THEY FIRE THEY NEVER2 MISS!
340 PRINT:PRINT"       HIT ANY KEY TO PLAY2
350 GETA$:IF A$="" THEN 350
360 GOTO 370
370 REM SET UP VARIABLES
380 J=50:R=INT((36)*RND(1))+1
390 REM CLS AND 24 CURSOR DOWNS
400 PRINT"3□□3"
410 X=32769:M=1:T=60
420 IFX<32769THENM=1
430 IFX>32806THENM=-1
440 REM CHECK FOR DIRECTION KEY
450 IFA$="R"THEN470
460 GOTO490
470 IFM=1THENM=-1:GOTO490
480 M=1
490 X=X+M:POKEX,150:POKEX-1,32:POKEX+1,32
500 IFPEEK(X+320)=215ORPEEK(X+320)=219THENGOTO990
510 IFPEEK(X+640)=214THENK=X+680:GOTO1000
520 IFFF=0THEN550
530 IFFF=1THENGOSUB630
540 IFFF=1THEN420
550 TT=(J-H):T=T+1:IFT<TTTHEN600
560 N=INT((3)*RND(1)):IFN=1THEN580
570 PRINTTAB(R)"w===25 6":GOTO590
580 PRINTTAB(R)")(===2■*n"
590 T=0:R=INT((36)*RND(1))
600 GETA$
610 IFA$=" "THENFF=1:F=X+40:GOSUB630
620 GOTO420
630 IFRI=1ORLE=1THEN1200
640 F=F+40
650 GETA$:IFA$="R"THEN660
660 GOTO700
670 IFM=1THENM=-1:GOTO700
680 M=1
690 REM DIRECT HIT?
700 IFPEEK(F)=215ORPEEK(F)=219THENH=H+1:GOTO870
710 POKEF-80,32
```





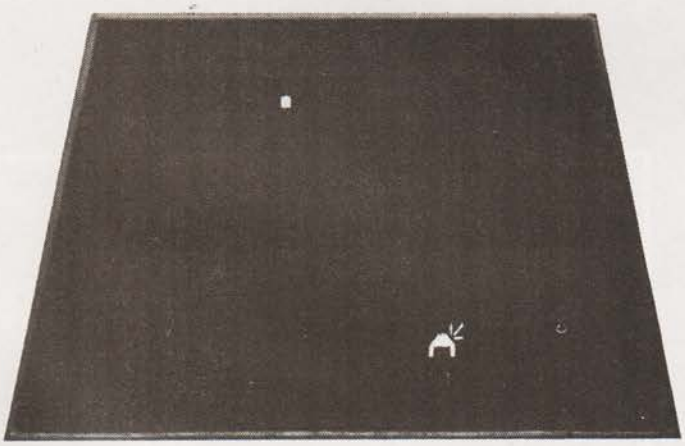


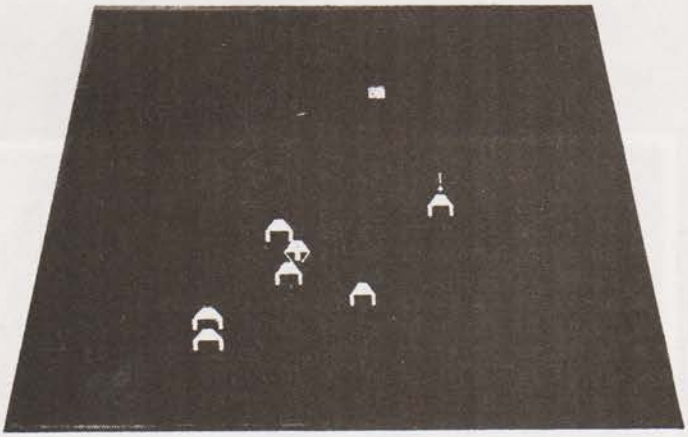
```
720 REM NEAR MISS?
730 IFPEEK(F)<>233THEN780
740 POKEF-40,93:POKEF-41,77:POKEF-1,68
750 FORQ=0TO80:NEXT:POKEF-40,32:POKEF-41,32:POKEF-1,32
760 D=1:RI=1:F=F-1:GOTO820
770 POKEF-80,32
780 IFPEEK(F)<>223THEN820
790 POKEF-40,93:POKEF-39,78:POKEF+1,68
800 FORQ=0TO80:NEXT:POKEF-40,32:POKEF-39,32:POKEF+1,32
810 D=1:LE=1:F=F+1
820 IFF>33728THENFF=0:D=0:RI=0:LE=0:POKEF-40,32:RETURN
830 IFD=1THENRETURN
840 POKEF,43:POKEF-40,93:POKEF-80,32
850 RETURN
860 REM DESTROY OUTTIE ROUTINE
870 POKEF-40,32:POKEF-80,32
880 FOR Q=0TO1
890 POKEF-1,43:POKEF+40,81:POKEF+1,127
900 POKEF,224:POKEF+39,90:POKEF+41,102
910 POKEF-1,102:POKEF+40,90:POKEF+1,224
920 POKEF,150:POKEF+39,43:POKEF+41,255
930 POKEF-1,32:POKEF+40,32:POKEF+1,32
940 POKEF,32:POKEF+39,32:POKEF+41,32
950 NEXTQ:FF=0
960 IFF=K-40THEN63999
970 D=0:RI=0:LE=0:RETURN
980 REM DESTROY DEFENDER ROUTINE
990 K=X+280
1000 IFPEEK(K)=150THEN1030
1010 POKEK,224:POKEK+40,32
1020 K=K-40:GOTO1000
1030 POKEK+40,32
1040 FOR W=1TO20:POKEK,211:FORQ=1TO10:NEXTO
1050 POKEK,150:FORQ=1TO10:NEXTO:NEXTW
1060 REM END GAME PRINTOUT
1070 PRINT"3:    YOU DESTROYED"H"OF THE ALIENS"
1080 REM KEYBOARD TRAP
1090 FOR Q=1TO10:GETA$:NEXT
1100 IFH2<HTHENH2=H:PRINT:PRINT"     IT IS THE BEST SCORE SO FAR":GOTO1120
1110 PRINT:PRINT"     THE BEST SCORE IS"H2
1120 PRINT:PRINT"     TO PLAY AGAIN PUSH ANY KEY"
1130 PRINT:PRINT"   AFTER 30 SECONDS I WILL SHUT DOWN"
1140 TI$="000000"
1150 IFTI$="000030"THEN END
1160 GETA$:IFA$=""THEN1150
1170 REM RESET VARIABLES THEN RESTART
1180 J=50:H=0:D=0:RI=0:LE=0:GOTO380
1190 REM REBOUND BOLT ROUTINES
1200 FLE=1THENK=41:GOTO1220
1210 K=39
1220 F=F+K:IFF>33728THENPOKEF-K,32:FF=0:D=0:RI=0:LE=0:RETURN
1230 IFPEEK(F)<>32THENPOKEF-K,32:H=H+1:GOTO1250
1240 POKEF,46:POKEF-K,32:RETURN
1250 IFPEEK(F+1)=215ORPEEK(F+1)=219THENF=F+1:GOTO870
1260 IFPEEK(F)=215ORPEEK(F)=219THEN870
1270 IFPEEK(F-1)=215ORPEEK(F-1)=219THENF=F-1:GOTO870
1280 IFPEEK(F-41)=215ORPEEK(F-41)=219THENF=F-41:GOTO870
1290 IFPEEK(F-39)=215ORPEEK(F-39)=219THENF=F-39:GOTO870
1300 IFPEEK(F+41)=215ORPEEK(F+41)=219THENF=F+41:GOTO870
1310 REM VARIABLE LIST
1320 REM A$ IS KEYBOARD RESPONSE
1330 REM X  IS POSITION OF DEFENDER
1340 REM R  IS POSITION OF OUTTIE
1350 REM M  IS DIRECTION MARKER
1360 REM FF IS FIRE MARKER
1370 REM F  IS THE BOLT POSITION
1380 REM K  IS THE OUTTIE BOLT POSITION
1390 REM RI IS THE RIGHT REBOUND MARKER
1400 REM LE IS THE LEFT REBOUND MARKER
1410 REM H  IS THE HIT COUNTER
1420 REM H2 IS THE HIGHEST SCORE
READY.
```

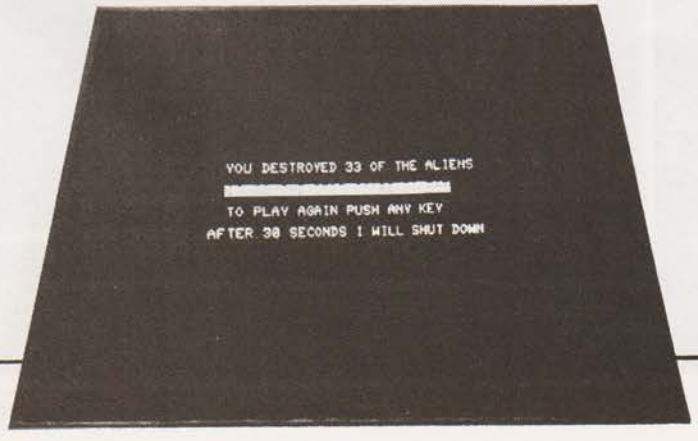
Historically some 341 battle craft got through and began to form up to attack the planet itself. Each of the orbital stations thus had an impossible job, faced by the ranks of approaching alien invaders. They fought well but still not well enough to prevent a sizable force reaching the surface.

Most of the attackers simply went around the forts, dispatching hordes of small robot hunters to wreak what havoc they could and passing on.

The battle of the orbital forts was one with no real victors . . . . . .







Space Invaders

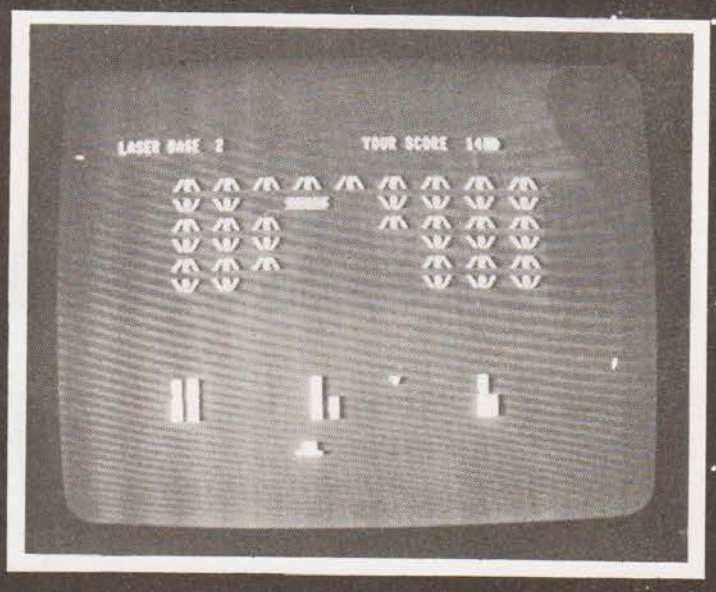
Instructions:
To move laser base left or right use left or right square brackets, to fire press the 'ESC' key. Only one key can be read at a time so these actions must be independant. The idea of the game is that there are 54 Invaders out to get you – for each one you hit you score 10 points. You, however, only have three laser bases so be careful!

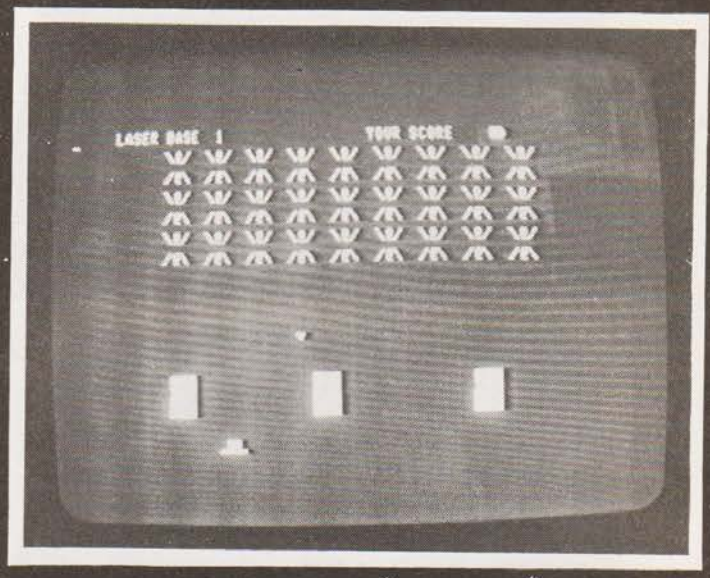
If you shoot down a whole frame of Invaders they reform closer to you, just to make things difficult. If, alas, you are shot to pieces and have no more bases left then just press 'G' and start all over again.

Variables Used

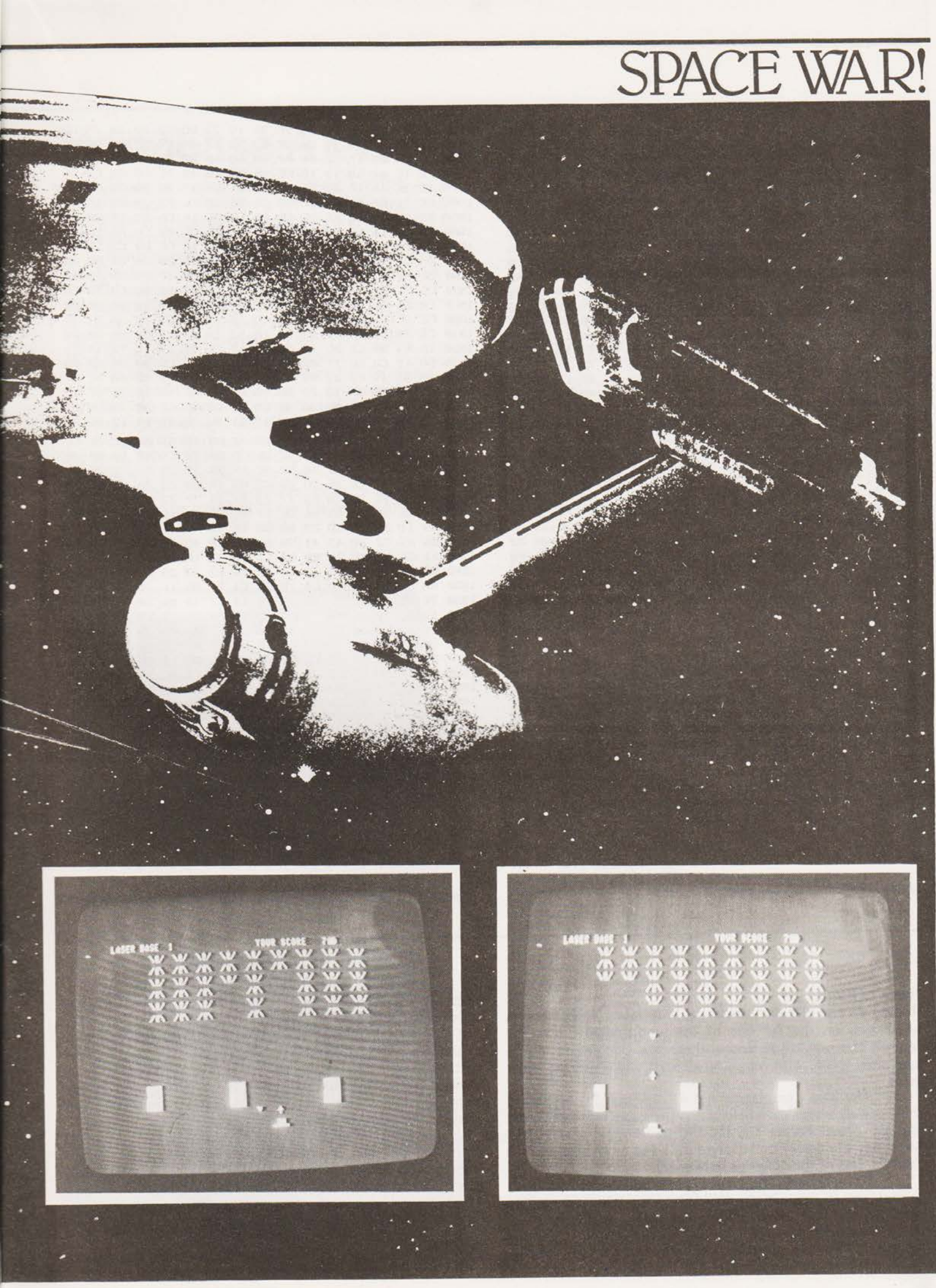
17CE	Laser number
17CF	Number of Invaders left
17D0	Display loop number
17D1	Displacement of Invaders
17D3	Move direction
17D4	Invader fire in progress
17D5	Keyboard byte
17D6	Laser fire in progress
17D8	Laser fire address
17DB	Invader fire address
17DD	Displacement of new frame
18E0	Size of frame
1842	Last Invader to fire

That's it, Good Luck!





SPACE WAR!



```
1600 40 1C CD C0 1A 36 03 23 36 36 23 36 36 23 36 48
1610 23 36 00 23 36 01 23 36 00 21 D6 17 3E 00 77 23
1620 77 23 77 23 77 23 77 23 77 2A 01 17 22 DD 17 00
1630 21 03 17 36 80 CD 20 1A 00 00 00 00 00 00 00 00
1640 CD E0 17 CD 43 1B CD D2 18 CD A6 17 CD A0 16 CD
1650 C4 17 C3 40 16 21 CE 17 7E 3D 77 00 CA E1 1A CD
1660 D9 1A CD B6 18 CD 61 1A CD 56 17 C9 2A DD 17 7D
1670 C6 80 D2 76 16 24 6F CD D0 19 22 DD 17 21 CF 17
1680 36 36 23 36 36 33 33 21 D2 17 C3 13 16 CD 72 1A
1690 C3 40 16 FE 7A C2 9A 16 36 7F FE 7F C0 36 20 C9
16A0 21 D4 17 7E FE 01 C0 2A DB 17 3E 20 77 7D C6 40
16B0 D2 B4 16 24 6F 7C FE 1F C2 C1 16 7D FE C0 D2 D5
16C0 16 7E FE 20 C2 CD 16 36 1F 22 DB 17 C9 CD 93 16
16D0 C3 F1 16 00 00 7E FE 20 CA F1 16 2B 2B 36 42 23
16E0 36 4C 23 36 41 23 36 4D 23 36 21 CD A6 17 C3 F7
16F0 16 21 D4 17 36 00 C9 21 D4 17 36 00 C3 55 16 00
1700 06 03 21 C0 14 E5 11 C0 1B 0E 40 1A 77 23 13 0D
1710 C2 0B 17 3E 80 E1 B5 D2 1B 17 24 6F 05 C2 05 17
1720 3A 03 17 FE C0 CA 39 17 21 C0 1B 01 40 00 CD 3A
1730 17 21 03 17 36 C0 C3 00 17 C9 23 0B 78 B1 C8 7E
1740 FE 71 C2 4B 17 36 72 00 C3 3A 17 FE 72 C2 00 1A
1750 36 71 00 C3 3A 17 21 C1 1F 3E 09 77 23 3E 18 77
1760 23 3E 08 77 00 C9 21 0C 1F 3E 7A 77 23 77 23 77
1770 21 1D 1F 77 23 77 23 77 21 2F 1F 77 23 77 23 77
1780 21 4C 1F 77 23 77 23 77 21 5D 1F 77 23 77 23 77
1790 21 6F 1F 77 23 77 23 77 C9 77 23 77 C9 AF 1F 77
17A0 23 77 23 77 C9 00 21 00 10 11 00 1C 1A FE FF C8
17B0 77 23 13 C3 AC 17 21 40 1C 7E FE FF C8 3E 20 77
17C0 23 C3 B9 17 21 D6 17 7E FE 01 CA 51 19 C9 00 23
17D0 05 8A 00 FF 00 9B 01 00 1A 1E 00 9B 1F 03 21 00
17E0 21 D0 17 7E FE 00 CA F1 17 35 CD 00 1B 00 00 00
17F0 C9 21 CF 17 7E 23 77 00 00 00 00 00 00 00 00 00
1800 21 D3 17 7E FE FF C2 24 18 21 04 1C CD 40 18 D2
1810 1A 18 21 D3 17 36 01 C3 70 18 2A D1 17 2B 22 D1
1820 17 C3 70 18 21 3A 1C CD 40 18 D2 35 18 21 D3 17
1830 36 FF C3 70 18 2A D1 17 23 22 D1 17 C3 70 18 00
1840 06 0F 7E FE 20 C2 57 18 3E 40 85 6F D2 50 18 24
1850 05 C2 42 18 D0 3F C9 2A D1 17 CD C0 18 7D C6 40
1860 D2 64 18 24 6F 22 D1 17 37 C9 00 00 00 00 00 00
1870 2A D1 17 EB 2A E0 18 E5 C1 21 00 1C 19 11 80 14
1880 1A 77 23 13 0B 79 B0 C2 80 18 C3 DD 19 00 00 00
1890 77 23 77 23 77 23 77 23 77 C9 3E 7F 77 C3 78 19
18A0 3E 20 77 C3 78 19 00 00 00 2A E0 18 E5 C1 21 80
18B0 14 CD 3A 17 C9 00 CD BC 00 0B 79 B0 C8 C3 B6 18
18C0 E5 EB 21 00 1C 19 06 32 3E 20 77 23 05 C2 CA 18
18D0 E1 C9 21 D5 17 DB 00 77 DB 00 BE CA E5 18 C9 00
18E0 4F 01 00 00 C9 FE DD CA 00 19 FE DB CA 15 19 FE
18F0 9B CA 2A 19 FE FB CA 2A 19 FE 8D CA 2A 19 C9 00
1900 21 FE 1F 11 FD 1F 06 3E 1A FE 20 C0 1A 77 1B 2B
1910 05 C2 0C 19 C9 21 C1 1F 11 C2 1F 06 3E 7E FE 20
1920 C0 1A 77 23 13 05 C2 21 19 C9 21 D6 17 7E FE 00
1930 C2 51 19 E5 21 C0 1F 3E 18 23 BE C2 39 19 7D D6
1940 40 D2 46 19 25 00 6F 22 D8 17 3E 7B 77 E1 36 01
1950 C9 2A D8 17 3E 20 77 7D D6 40 D2 5E 19 25 6F 7C
1960 FE 1C C2 6B 19 7D FE 40 DA 78 19 7E FE 20 C2 80
1970 19 3E 7B 77 22 D8 17 C9 21 D6 17 36 00 C9 00 00
1980 FE 71 CA 83 1A FE C0 CA 83 1A FE 72 CA 83 1A FE
1990 7A CA 9A 18 FE 7F CA A0 18 FE 1F CA 72 1A 00 00
19A0 CD 20 1B CD A9 18 21 CF 17 7E FE 00 CA B3 19 00
19B0 C3 78 19 E1 00 C3 6C 16 3A 42 1B FE 00 C2 55 1B
19C0 2A E0 18 0E 00 C3 6C 1B 00 00 00 00 00 00 00 00
19D0 7C FE 01 C2 D9 19 C3 B2 1B 22 D1 17 C9 2A E0 18
19E0 E5 C1 21 80 14 CD 3A 17 3A D6 17 FE 00 C8 2A D8
19F0 17 7E FE 7B C8 FE 20 C2 80 19 36 7B C9 00 00 00
1A00 FE 1F C2 3A 17 36 20 C3 3A 17 20 20 72 C0 71 20
1A10 CD 0B 00 FE 47 C2 10 1A 33 33 C3 02 16 00 00 00
1A20 CD E3 00 CD B6 17 CD 00 17 CD 00 1B CD 70 18 CD
1A30 56 17 CD 66 17 00 00 00 CD A6 17 C9 00 00 00 00
1A40 2A D1 17 EB 21 00 1C 19 01 80 01 11 00 00 7E FE
1A50 C0 C2 55 1A 13 23 0B 78 B1 C2 4E 1A 7B 32 CF 17
1A60 C9 21 C0 1F 06 40 3E 20 77 23 05 C2 68 1A C9 00
1A70 21 20 36 05 E5 CD A4 1B E1 36 20 21 D4 17 36 00
1A80 C3 78 19 2B 2B E5 3E 05 CD 90 18 CD A6 17 21 CF
1A90 17 35 CD A0 1A E1 3E 20 CD 90 18 C3 A0 19 00 00
1AA0 21 30 1C 7E FE 20 C2 AC 1A 36 31 C9 3C FE 3A CA
1AB0 B4 1A 77 C9 36 30 2B C3 A3 1A 20 20 20 20 20 20
1AC0 21 2D 1C 3E 20 23 77 23 77 23 77 23 77 3E 30 77
1AD0 21 11 1C 36 31 21 CE 17 C9 21 11 1C 34 01 00 01
1AE0 C9 11 EA 1A CD 23 00 C3 10 1A 47 41 4D 45 20 4F
1AF0 56 45 52 20 43 41 50 54 27 20 4C 41 53 45 52 04
1B00 21 CF 17 46 21 00 00 11 80 14 1A FE C0 C2 14 1B
1B10 05 CA 19 1B 23 13 C3 0A 1B 23 23 23 22 E0 18 C9
1B20 2A D1 17 EB 2A E0 18 E5 C1 21 00 1C 19 11 80 14
1B30 7E FE 1F C2 38 1B 3E 20 12 23 13 0B 78 B1 C2 30
1B40 1B C9 16 3A D4 17 FE 00 C0 2A D1 17 EB 21 00 1C
1B50 19 EB C3 B8 19 47 4F 2A E0 18 00 2B 13 7D B4 CA
1B60 9E 1B 1A FE C0 C2 5B 1B 05 C2 5B 1B 13 2B 7D B4
1B70 CA 9E 1B 1A FE C0 C2 6C 1B 0C D5 7B C6 40 D2 82
1B80 1B 14 5F 1A FE 20 CA 8D 1B D1 C3 6C 1B EB 36 1F
1B90 22 DB 17 21 D4 17 36 01 E1 79 32 42 1B C9 3E 00
1BA0 32 42 1B C9 21 42 1B 7E FE 00 CA AE 1B 35 CD A6
1BB0 17 C9 7D FE C0 DA D9 19 21 48 00 C3 D9 19 00 00
1BC0 20 72 C0 71 20 20 72 C0 71 20 20 72 C0 71 20 20
1BD0 72 C0 71 20 20 72 C0 71 20 20 72 C0 71 20 20 72
1BE0 C0 71 20 20 72 C0 71 20 20 72 C0 71 20 20 20 20
1BF0 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
1C00 20 20 20 20 20 20 4C 41 53 45 52 20 42 41 53 45 20
1C10 20 33 20 20 20 20 20 20 20 20 20 20 20 20 20 20
1C20 20 20 20 59 4F 55 52 20 53 43 4F 52 45 20 20 31
1C30 39 30 00 20 20 20 20 20 20 20 20 20 20 20 20 20
1C40 20
FUNCTION? P Q J E R C G A D U H L F T S I O W M V X N Z K
```

Above : Space Invaders hex dump.

Planet In Ruins

Rome had one planetary moon, appropriately named Sicily, which was on the far side of the world when the attack reached the surface of Rome, there was one armed moonbase sited there, with only a small staff and a meagre armament.

The base Commander did what he could – his survey ships sowed a huge minefield across the space between Rome and the Travel Points. Closing the stable door it may have been, but the demolition charges took out more enemy ships than the rest of the defences between them.

Rome itself was destroyed utterly. Clouds of ash drifted across the surface and the mean temperature had risen to 200°F (a local temperature scale) across the main landmasses. About 50% of the surface water had been vapourised into the upper atmosphere, and once the temperature fell sufficiently there came about a storm such had never raged across the planet since its creation.

By that time though the Outsider fleet had long gone – and run straight into Moonbase's minefield. Deploying for battle, they only succeeded in englobing the explosive devices thereby catching more of the blast from each as they went off. Their tactics were well nigh suicidal, suggesting that they were unused to dealing with this type of attack.

The remainder of their force moved off . . . . . or so Moonbase believed. Some hours later alarms clanged a warning through the corridors andthe last remaining human outpost in the system was fighting for its life against a squadron of small fast alien attackers.

Seconds after the attack began, fire of the twenty assault craft had been brought down, but at the cost of all but one of the base's cannon . . . . . .

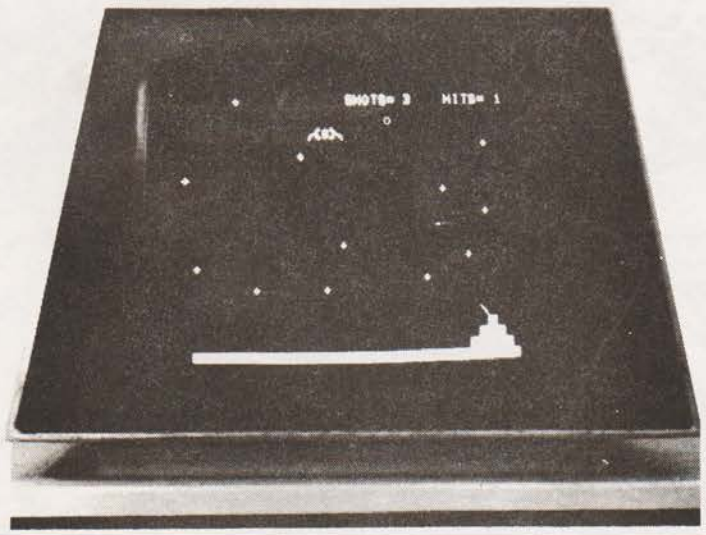
Moonbase Alert

It is essentially an application of the PEEK & POKE Functions to produce an interactive game whereby you are able to fire a gun at flying spacecraft. Scoring is incorporated to provide some competitiveness.

Points to note within the program are as follows:—

(a) The clear screen instructions have been printed out as, "3" and two cursor up instructions as "11".
(b) Lines 280–400 Generate Moon Surface and Base.
(c) Lines 410–470 Generate Star background.
(d) Lines 520–570 Determines Flight Path of ship.
(e) Lines 580–630 Pokes ship on screen.
(f) Line 680 Peeks next position of shell so following lines prints a shell or if ship is hit, prints explosion.
(g) Line 760 The present rate of Poking on and off the screen is about right but this line could be used to slow the game down to any desired speed.
(h) Lines 770–820 Pokes the ship and shell off.
(i) Line 850 Strikes the ship off the screen if hit.

If the game is to be run on a different machine some of the lines will have to be modified to suit the revised formatting but the principle remains the same.




```
READY.

 100 PRINT"3"
 110 PRINTSPC(13)"----------------"
 120 PRINTSPC(13)"MOONBASE ALERT!"
 130 PRINTSPC(13)"----------------"
 140 PRINT:PRINT:PRINT
 150 PRINT"MOONBASE IS UNDER ATTACK FROMALIEN":PRINT
 160 PRINT"INVADERS!! YOU HAVE ONLY ONE LASER":PRINT
 170 PRINT"CANNON TO DEFEND THE BASE AND THERE":PRINT
 180 PRINT"ARE ONLY 15 SHOTS REMAINING":PRINT
 190 PRINT"...KEY 1 TO FIRE...":PRINT
 200 PRINT"IF YOU HIT TEN SHIPS BEFORE":PRINT
 210 PRINT"RUNNING OUT OF AMMO THE ATTACK":PRINT
 220 PRINT"HAS BEEN DEFEATED":PRINT
 230 PRINT:PRINT
 240 PRINT"...KEY 2 TO START..."
 250 GET A:IF A=0 THEN 250
 260 ON A GOTO270,290
 270 PRINT"3":GOTO 240
 280 REM***MOON SURFACE AND BASE***
 290 PRINT"3"
 300 POKE 32768+(40*20)+34,77
 310 POKE 32768+(40*21)+35,160
 320 FOR X=1 TO 3
 330 POKE 32768+(40*22)+33+X,160
 340 NEXT X
 350 FOR Y=1 TO 5
 360 POKE 32768+(40*23)+32+Y,160
 370 NEXT Y
 380 FOR Z=1 TO 38
 390 POKE 32768+(40*24)+Z,102
 400 NEXT Z
 410 REM***BACKGROUND STARS***
 420 DATA 45,234,252,320,389,474,577,632,641,707,727,735
 430 FOR X=0 TO 11
 440 READ A
 450 POKE 32768+A,43
 460 NEXT X
 470 FOR A=1 TO 1000:NEXT A
 480 T=0:M=0:REM***TOTALS SHOTS AND HITS***
 490 N=0:S=0:REM***SHELL HEIGHT AND SHIPS***
 500 S$="SHOTS="
 510 H$="HITS="
 520 REM***HEIGHT OF SHIP***
 530 D=INT(10*RND(1)+.5):N=0:W=0
 540 S=S+1
 550 IF D>=7 THEN C=4:GOTO 580
 560 IF D<=3 THEN C=7:GOTO 580
 570 IF 3<D<7 THEN C=13:GOTO 580
 580 FOR X=0 TO 35
 590 POKE 32768+(40*C)+X,85
 600 POKE 32768+(40*C)+X+1,60
 610 POKE 32768+(40*C)+X+2,87
 620 POKE 32768+(40*C)+X+3,62
 630 POKE 32768+(40*C)+X+4,73
 640 IF N<>0 THEN 670
 650 GET B:IF B=0 THEN GOTO 760
 660 IF B>0 THEN T=T+1:PRINTSPC(18)S$T:PRINT"11"
 670 N=N+1
 680 LET W=PEEK(32768+(40*(19-N))+33-N)
 690 IF W=85 OR W=60 OR W=87 OR W=62 OR W=73 THEN 710
 700 GOTO 750
 710 POKE 32768+(40*(19-N))+33-N,42
 720 M=M+1:PRINTSPC(30)H$M:PRINT"11"
 730 IF M=10 THEN GOTO 880
 740 GOTO 760
 750 POKE 32768+(40*(19-N))+33-N,46
 760 REM
 770 POKE 32768+(40*C)+X,32
 780 POKE 32768+(40*C)+X+1,32
 790 POKE 32768+(40*C)+X+2,32
 800 POKE 32768+(40*C)+X+3,32
 810 POKE 32768+(40*C)+X+4,32
 820 POKE 32768+(40*(19-N))+33-N,32
 830 IF N=21 THEN N=0:GOTO 860
 840 IF T=15 THEN GOTO 990
 850 IF W=85 OR W=60 OR W=87 OR W=62 OR W=73 THEN 530
 860 NEXT X
 870 GOTO 530
 880 PRINT"3":PRINT:PRINT
 890 PRINT"CONGRATULATIONS!! YOU HAVE SAVED":PRINT
 900 PRINT"MOONBASE FROM THE ATTACK!":PRINT:PRINT
 910 PRINT"THE CONFEDERATION IS PROUD OF YOU":PRINT
 920 PRINT"TYPE 'RUN' IF YOU WISH TO PLAY":PRINT
 930 PRINT"AGAIN.":PRINT:PRINT
 940 PRINT"NUMBER OF SHIPS THAT ATTACKED="S
 950 PRINT"YOUR SCORE!"
 960 PRINTSPC(11)"SHOTS TAKEN="T
 970 PRINTSPC(11)"HITS MADE  ="M
 980 END
 990 PRINT"3":PRINT:PRINT
1000 PRINT"YOU HAVE JUST RUN OUT OF AMMO!":PRINT
1010 PRINT"THE MOONBASE HAS BEEN DESTROYED"
1020 PRINT:PRINT:PRINT"TYPE 'RUN' IF YOU WANT TO TRY AGAIN".
1030 PRINT
1040 PRINTSPC(11)S" SHIPS ATTACKED":PRINT
1050 PRINT"YOU HIT ";M;" WITH ";T;" SHOTS"
1060 END
READY.
```

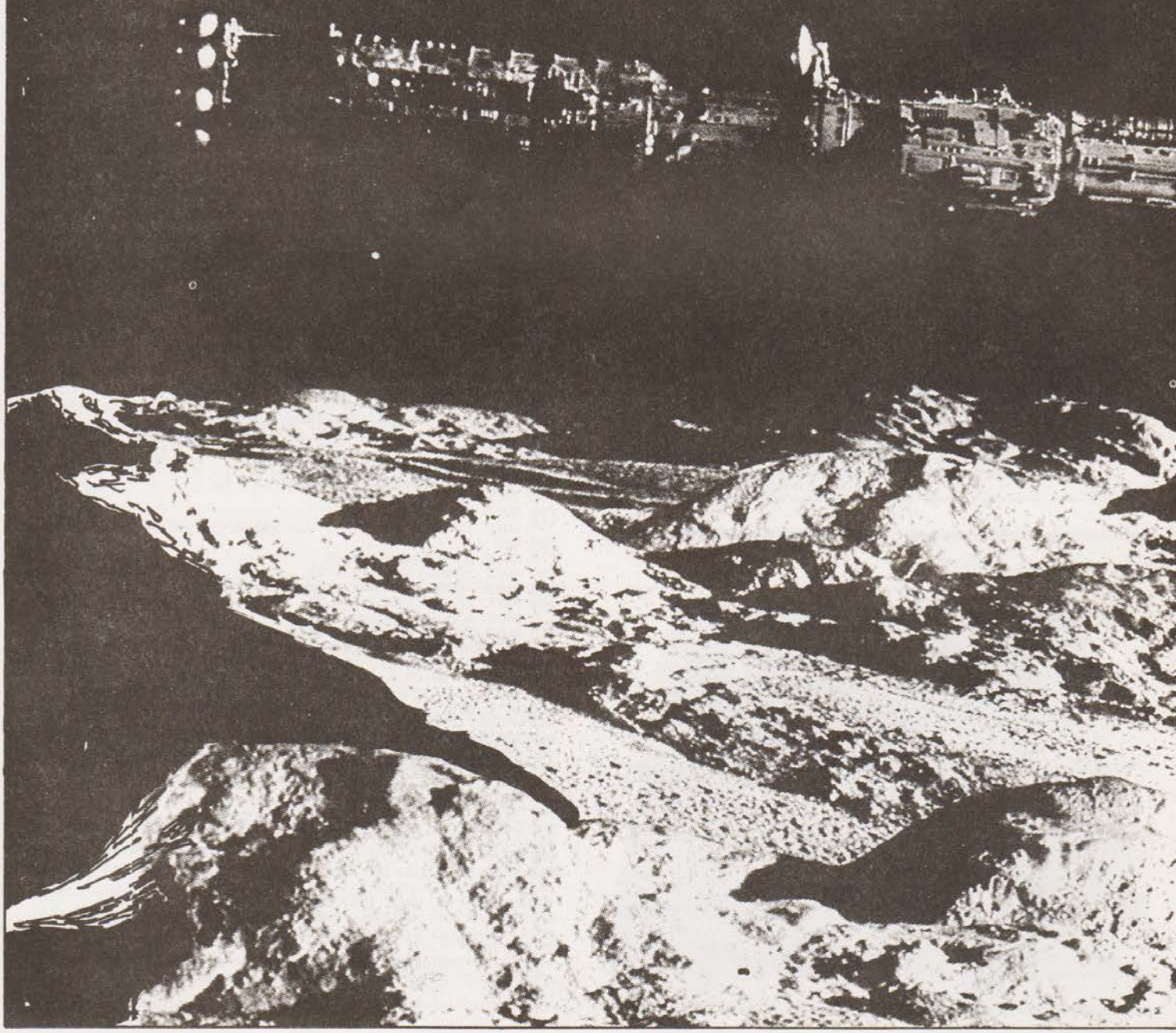
Aftermath

With the destruction of Moonbase, all human life had been eradicated from the system. It was six days before the 'help' from Earth arrived, a single Empire class dreadnought. Had it been present at Rome when the Outties attacked, it is possible that it could have stood off their fleet long enough to allow a greater firepower to be brought to bear.

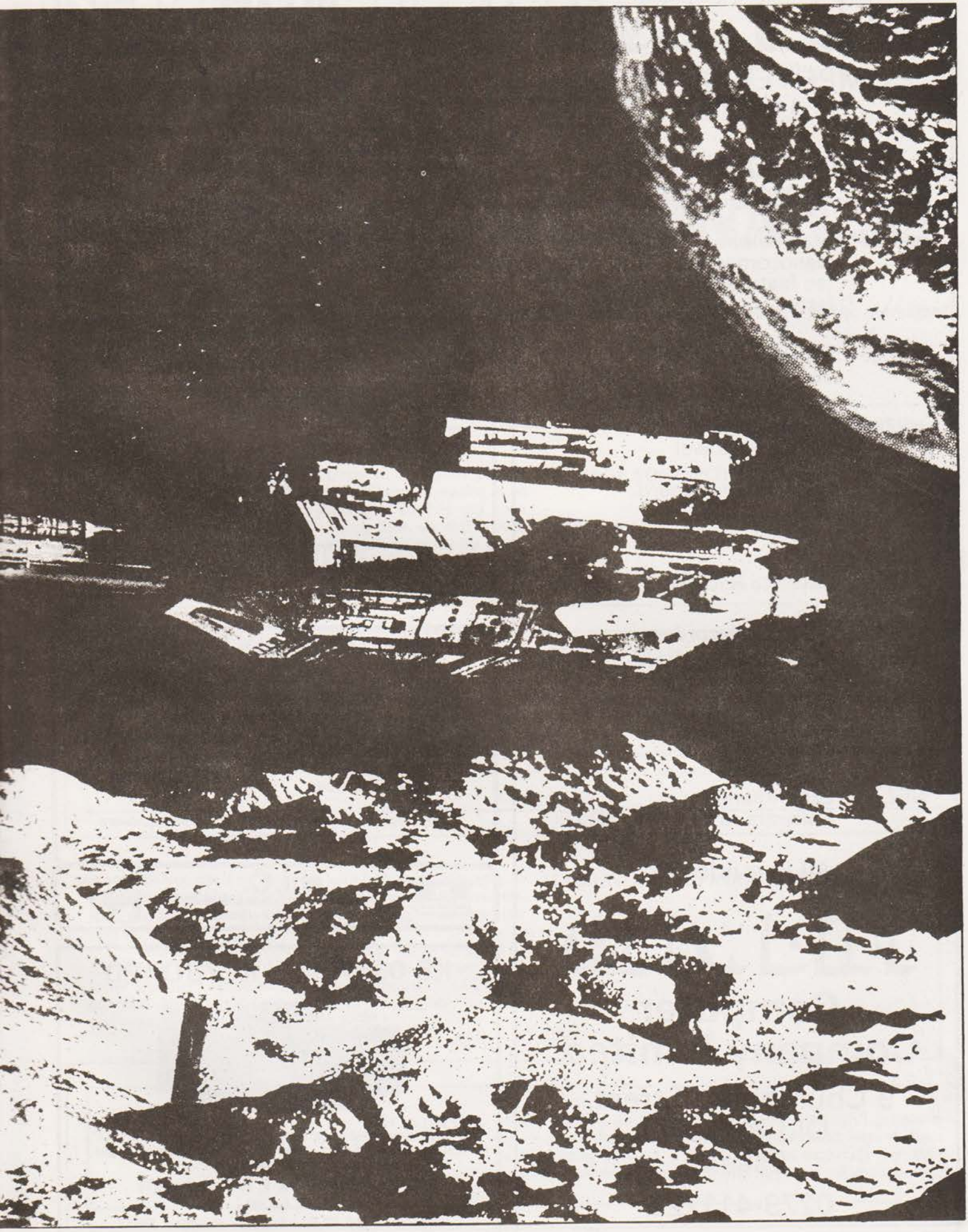
Even this, though, is doubtful. The invaders used tactics and weapons totally alien to humanity and this lack of correlation cost the fleet dearly when they did catch up with the Outties in the Nexus system two years later. At that battle it cost four Empire ships and dozens of small corvettes to buy the destruction of the Outtie force.

Since no contact was ever made with the aliens, we have no way of knowing where they came from, or even if the incident will remain an isolated one. Analysis of debris from their ships has given us only scraps of information, around which many theories have already been constructed. Simply we do not know enough to be able to say with confidence that the Outties will not re-appear, even now – two hundred years later.

At the time the only good to come of the war was the forming of the Co-prosperity Sphere, with a united defence force and an overall command structure. Trade has prospered since and that elusive threatening shadow has served to keep mankind united.



SPACE WAR!



computing today

WHAT TO LOOK FOR IN THE APRIL ISSUE ON SALE MARCH 11TH.

PROGRAMERS BONANZA!

Anyone who uses any computing language — including profane — should be camping in the newsagents waiting for next month's CT. Why? Well it includes . . . . . .

16 PAGE SOFTSPOT SPECIAL

A full sixteen page program supplement, absolutely packed out with brand new brilliant readers software. Covering most of the systems around, these ideas and routines will keep your RAMs happily loaded for a long time, we think! And with 16 pages to choose from you won't be stuck for something to run next month.

BUILDING UP A PROGRAM LIBRARY

Fed up with screen filling nonsense? Tired of computing all the prime numbers in existance? Shot down your last Death Star? Ready to begin making your micro work? Well if you are — and you should be, too many names will ruin your health — next month Computing Todays A.P.Stephenson tells us how to go about building up a useful program library. Womp rat fanatics — eat your hearts out.

MACHINE CODE PROGRAMMING

It may be you can't be bothered with high level languages, or simply that machine code has always seemed simply inaccessable claptrap fit only for walking adding machines, not people.

Well Mr Malcolm (NASCOM) Bell has an idea that he can change all that. He thinks machine code programming is faster and more suited to some applications than BASIC and co. Next month we give the chance to prove it. May just have you typing in hex yet!

PICO-BASIC

Micro systems deserve micro languages. You can't get much more micro than an MK 14 now can you? Next issue we have a fascinating look at a BASIC version especially for that machine. We think that you'll find its power quite surprising.

Acknowledgements. Our grateful thanks go to AET Petsoft, Acorn Computers, Midwich Computer Company, Nascom Microcomputers and Star Devices for their generous assistance.

If you fancy a 16 K PET with goodies galore, a Nascom, Nano or Acorn - or even a keyboard then read with care. Any one of these could be yours by entering our birthday competition.

Our birthday is a time of generous celebration and to help you enjoy yourselves as well we are offering some fantastic prices for a simple competition. No writing silly slogans or spending hours trying to write a program, just a straightforward crossword. The prices we are giving away are as follows:—

1st Prize16K PET with Petsoft Toolkit and £300 worth of Petsoft programs of your choice, not business packages.
2nd PrizeA Nascom 2.
3rd PrizeA Nanocomputer.
4th PrizeAn Acorn.
5th PrizeA Star Devices touch keyboard.

All you have to do is solve the crossword!

CROSSWORD RULES

The squares of the crossword have been numbered in a conventional manner but only the clues for 1 across and 1 down have been indicated. Your first task is to solve all the clues and fit the answers into the appropriate squares. The second task is to find all the locations in the crossword where two answers cross, for example where 2 down and 7 across meet, and total the (decimal) value of the letters, A being equal to 1 and Z equal to 26. Then, put the completed crossword into an envelope, seal it and send it to us with your total written on the

1000+ BIRTHDAY COMPETITION

flap of the envelope. If you don't put the total on the envelope your entry will not be marked.

RULES

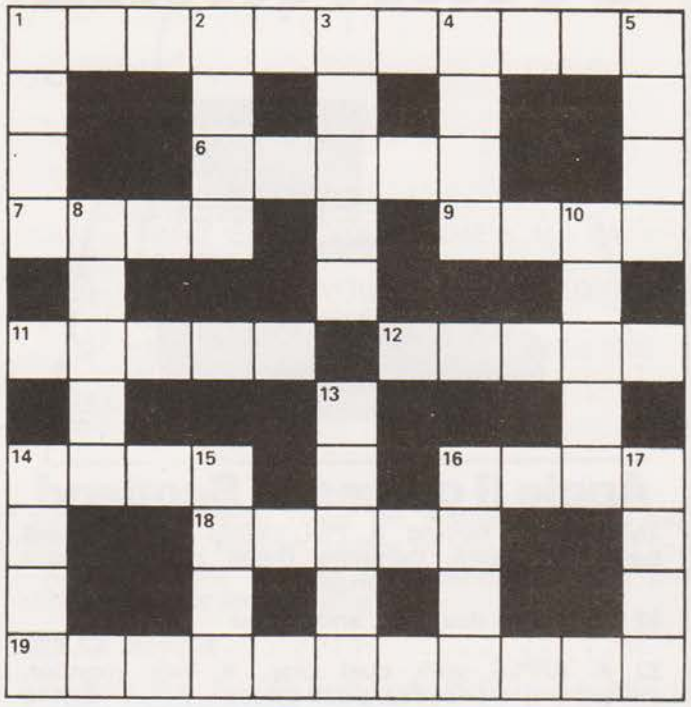
This competition is open to all UK and Northern Ireland readers of the magazine except employees of the magazine, their printers, distributors, employees of Commodore UK, Petsoft, Nascom Microcomputers, Midwich Computer Company, Acorn Computers, Star Devices or anyone associated with the competition.

All entries must be on the coupon cut from the magazine, photostats are not acceptable. As long as the correct coupon is used readers may submit as many entries as they wish.

Completed entries must be sent to Computing Today, 145 Charing Cross Road, London WC2H 0EE and marked CT Competition. Entries not having the code number on the envelope flap will be discarded.

The prizes will be awarded to the first five correct entries drawn after the closing date. No correspondence will be entered into with regard to the results, it is a condition of entry that the judges decision is final.

All the winners will be notifed by post and the results will be published in a future issue of CT.



CLUES

An instructive African country in turmoil. (4)
Putting a penny in a confused leap will be fruitful. (5)
1A) Moves a toddler might make when programming? (6,5)
In the workshop we tested a shopsoiled computer. (11)
The options are many for this groovy item. (4)
1D) Indicative of the magnitude? (4)
Data rots in confusion if not put in order. (4)
Your forefinger can be used to trace this list. (5)
The route a computer might take when it leaves. (4)
With this mode my primary objective is to communicate. (5)
I was in front once, boredom resulted! (5)
Send in panic resulting in a software termination. (5)
What an out of work processor looks for. (1,3)
A converted amphibian will produce food for a micro.(1,2,1)
Wipe out your mistakes with a rubber. (5)
A singular arboreal data structure? (4)
Draw round a troubled crate. (5)
Planting one in a random statement may result in 12 across. (4)
Language that sounds like it was meant for the shoe trade.(5)
Only one input can give a valid answer with this logic. (2-2)
Nothing mixed with an abbreviated Baronet can save the day if your program runs amok! (5)
On a Northerly heading we find a backward educational computer in shorts. (4)

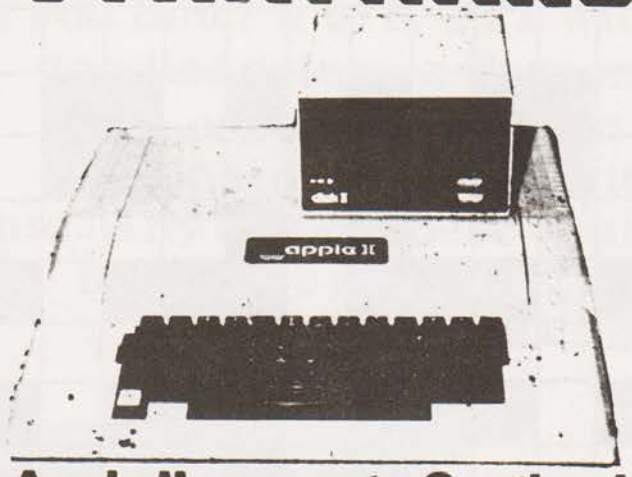
Name .....

Address .....

.....

.....

STRATHAND



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20	17p	58p
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24	21p	63p
28	27p	70p
40	37p	109p

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John Owen

TRITON STRINGS

The Machine-Code routine given in Listing 1. allows 'Triton' V5.1 BASIC to handle four 'string variables' of up to 15 characters each, or two strings of up to 31 characters each, or one string containing up to 68 characters.

The strings are designated A,B,C,D and E and can be 'written into' by BASIC at any time using the Command – CALL I,n and recalled at any time using the Command CALL O,n where 'n' is a variable A,B,C,D or E.

The Command 'CALL T' will automatically compare the strings in A and C and return with the BASIC variable 'Q' set as below :

If A > = C then Q=1 otherwise Q=0

After the Machine-Code routine has been entered, use the 'Direct Basic Command' POKE 5249,8014. This changes the contents of locations 1481 and 1482H to 1F4EH, the start of the Machine-Code routine, and 'signals' the end of memory available for Basic programs. Before loading a completed program onto tape, use the 'Direct Command' POKE 5632,8120 to change the address at 1600 and 1601H to 1FB8H, the end of the Machine-Code program.

EXAMPLE 1

```
10  LET I=8014, 0=8046
20  PRINT 'WHAT IS YOUR NAME ? ',;CALL I,A
30  PRINT
40  PRINT 'HELLO',;CALL O,A;PRINT 'I HOPE
    ARE WELL ! '
50  STOP
```

In this example I and O are first 'set up' with the call addresses of the IN and OUT routines. After the CALL I in line 20 the routine first checks for a comma after the call address and will go to the error exit if no comma is found. On finding a comma, the routine obtains the address of the variable (ie A,B,C,D or E). The routine will again go to the error exit if the variable is not valid. If all is 'well' the routine uses this address to calculate the 'starting' address of the string variable called, sets up the DE register and calls 'Indata' in the Monitor.

CALL O in line 40 goes through a very similar routine except that it puts 04H in location 1FFF H before calling 'Pdata' in the Monitor. This is because 'Pdata' will not return until it 'sees' the 'end of the text' marker (04) and if a long CALL I has 'overflowed' into non-existent memory beyond 1FFF H, the 04 marker would be missing. Also, of course, 04 would be missing if a CALL O was made to a non-existent string.

EXAMPLE 2

Add the following lines to Example 1.

```
15  LET T=8083, C=8152
50  POKE C,74;POKE C+1,79;POKE C+2,72;POKE
    C+3,78;POKE C+4,4
60  PRINT 'ENTER YOUR NAME',;CALL I,A
70  PRINT;CALL T
80  IF Q=1 PRINT 'YOU HAVE ENTERED THE
    CORRECT NAME';GOTO 100
90  IF Q=0 PRINT 'YOU HAVE ENTERED THE
    WRONG NAME – TRY AGAIN'
95  GOTO 50
100 STOP
```

In this example, line 50 'Pokes' the 'password' (JOHN) into string variable 'C', the start address of which was set in line 15 (C=8152). Line 70 calls the comparing routine and returns with 'Q' set for lines 80 and 90.

Note that line 50 ends with POKE ––,4. This is required by the CALL T routine. Note also that, for the CALL T routine, the 'Data' must always be put in variable 'C', the string to be tested always being put in variable 'A'.

Given below are the Hex and Decimal addresses of the routines etc.

HEX	DECIMAL	FUNCTION
1F4E	8014	Places string in memory area indicated by variable after comma in CALL I
1F6E	8046	Calls string from memory area indicated by variable after comma in CALL O
1F93	8083	Compares strings in A and C and returns Q=1 if A > =C
1FB8	8120	Start of string 'A'
1FC8	8136	Start of string 'B'
1FD8	8152	Start of string 'C'
1FE8	8168	Start of string 'D'
1FF8	8184	Start of string 'E'

```
1F4E  CD BD
1F50  09 2C 2E CD 8B 09 7D A7 D6 80 17 17 17 C6 A0 DA
1F60  32 09 D5 5F 16 1F CD 1B 00 D1 C9 C3 32 09 21 FF
1F70  1F 36 04 CD BD 09 2C 0A CD 8B 09 7D A7 D6 80 17
1F80  17 17 C6 A0 DA 32 09 D5 5F 16 1F CD 23 00 D1 C9
1F90  C3 32 09 D5 21 A3 14 36 00 23 36 00 21 B8 1F 11
1FA0  D8 1F 1A FE 04 CA B1 1F BE C2 B6 1F 23 13 C3 A2
1FB0  1F 21 A3 14 36 01 D1 C9  – – –  Table area to 1FFF
```

Note: In BASIC : 10 LET I=8014, O=8046, T=8083

Listing 1 Complete listing for 'String Variables' with 'TRITON' V5.1 BASIC.

A.P.Stephenson

Just how many bytes can you get from an Apple ? We have taken a look inside the ITT 2020, its close relative, and report on what we found.

Regular readers of CT may remember an article entitled "PET IMPRESSIONS" which I wrote in the December issue, shortly after buying the 8K model. Apart from a few grumbles about the data tape transfers and the operating manual I gave the general impression that the PET is good value for money and worthy of a place in any home. Since that time, nothing has happened to change my opinion of Commodore's brain-child. A few weeks ago however, we had an addition to the family, not the bellowing type that keeps you awake but in the shape of a slim grey box about four inches high with the disarming appearance of an office typewriter with the lid on. It introduced itself as the ITT 2020 APPLE SYSTEM and boasted that it had 48 K's worth of RAM smoldering away and the capability to present its data output in full technicolour with audio accompaniment. The device now sits on the same table as my PET with a colour TV sandwiched between them, acting as a kind of United Nations mediator charged with keeping the peace.

Like Father, Like Son

I think it would be advisable at this point to dispell any false impressions regarding my affluence and ability to buy a PET one month and an APPLE shortly afterwards. The explanation is reasonably benign. My son, who previously betrayed little interest in computing subjects, started tapping away at the PET (*my* PET) and after a few hours of high voltage questioning started writing programs which, to my annoyance, worked first time (mine never seem to!). For the next week, I was virtually excluded from the keyboard and resigned to reading Wuthering Heights for the third time. This frightening prospect was mercifully relieved by a formal announcement from my son that he was going to buy a computer for himself. After a few weeks lull, during which every magazine and trade journal remotely connected with the microprocessor art was devoured, a decision on the APPLE was reached. A day or so later, the small grey box left the portals of MICRODIGITAL in Brunswick Street Liverpool and was placed with due reverence on the table in the previously described position. I was given special dispensation to operate the machine when it was not "occupied", although in practice this privilige has turned out to be rather infrequent. In spite of this, I have managed to fathom out the operating system, dissect some of the hardware mysteries and finally gain an overall impression of the intruder's capabilities.

The Apple Family Tree

Because the generic title "APPLE" covers a variety of subspecies, it is necessary to define the particular model in the correct perspective. The design of the APPLE and its manufacture was due to the energy and expertise of a young american, Steve Wozniac. It rapidly became a kind of indu-- try standard in the American hobby market and also achieved high volume sales in the "small-business" area. It eventually infiltrated to this country in two guises ; the normal APPLE with simple modifications to the power supply to suit our 230 volt mains and a closely similar model manufactured by ITT and called the "ITT 2020". I am not qualified to judge which is the "best", in fact there would appear to be little merit is posing such a question because of the close generic correspondence. However, the following observations are based on the ITT 2020.

Documentation Package

In general, the support literature which comes with the model is superb. It consists of "The APPLE II REFERENCE MANUAL", "BASIC PROGRAMMING REFERENCE MAN-

UAL" "APPLE II BASIC PROGRAMMING MANUAL" and the "2020 MICROCOMPUTER SYSTEM which explains the few subtle variations whcih distinguish it from the parent APPLE. Within this package is the most complete and unequivocal definition of the BASIC language I have ever seen. It was clearly the work, not only of a man that knows his subject, but also an expert in the communication of ideas. There is also an extremely useful pull-out card of the BASIC statements in abbreviated form which after a time, would be the major programming weapon. There is one relatively minor criticism which spoils an otherwise perfect quartet ; the "2020 MICROCOMPUTER SYSTEM" does not fully cover the various differencies between the APPLE and the 2020.

In conformity with the established practice of providing for a wide range of pockets, the options include a choice of 16K, 32K or 48K of RAM on board. BASIC is available in either of two forms : INTEGER BASIC in ROM with FLOATING POINT BASIC available as an extra on tape or vice versa. The floating point version is called APPLESOFT. There are a few minor differences between the two. There is also a choice between black and white or colour output. We shall assume the colour version, 48K of RAM and Floating Point BASIC in ROM.

Getting It Working

First get your colour TV (with apologies to Mrs Beaton). Not everyone has a colour TV and very few households have a *spare* one so this would normally entail some delicate diplomatic approaches to the rest of the family group. Assuming these are successful, the lead (supplied with the 2020) carrying the r/f modulated signal is plugged into the aerial socket and everything is switched on. In our case, the immediate effect is a rather pleasant little tinkle from the speaker inside the 2020 whcih we have since learned is a reassurance, that all is well. A spare channel on the TV was then tuned until, finally, a rather strange pattern of multiple question marks appeared which is the calling card of the machine operating system. The pattern was very jumpy and kept flashing on and off in spite of an orgy of twiddling with the TV controls and tuning.

When all else fails, it is a good plan to read the instructions. . .which we did. Apparently there is another adjustment required inside the 2020 to adjust the output signal level to suit the various sensitivities of commercial TVs. The output in our case was far too high and resulted in overloading the aerial input circuits. The top cover of the 2020 was removed (a simple snap fit without fiddly screws), the adjustment screw was easily identified, close to the output lead itself, and turned anticlockwise until the picture was stable. There appears to be ample signal strength in reserve to cater for the most sluggish TV model. The pattern is presented in black and white because the colour requires a BASIC command before it appears.

The Operating System

No attempt will be made to describe this button by button. In comparison with the almost idiot-proof PET, operation demands a modicum of intelligence. Under power-on conditions with the reset button pressed you are not yet in the comfortable environment of BASIC. The prompt is an asterisk to indicate the operator is in the machine monitor regime. Holding the shift key down whilst pressing "B" releases a square bracket and a flashing cursor, the trade mark of the BASIC interpreter. The third option, according to the "APPLE II REFERENCE MANUAL" is the "MINI-ASSEMBLER" system which can be obtained by keying the hexadecimal number F666 then G. This should display the symbol "!" which is the Assembler prompt.

This didn't work. To solve the mystery, the manual was again consulted and the assembler listing studied, together with machine code listing at the keyboard. There was certainly no assembler at the address stated so, on the assumption it may be at another address block, a vain attempt was made to locate it a block at a time. This was abandoned due to eyestrain after a few hundred "pages" had been scanned. A call was later made to MICRODIGITAL. One of their engineers solved the problem in approximately seven seconds. The reason the assembler didn't come up was very simple, there wasn't one in it! Apparently the version with Floating Point BASIC in ROM does not include the assembler. This is one example of the criticism made earlier regarding the discrepencies in the manual.

The Display

After serving an apprenticeship on the PET, a sharp, crisp display is soon taken for granted. This is due to two factors : first, the PET screen is small which improves the apparent resolution of the characters and second, the display circuitry is designed specifically for a character display. A twenty inch domestic colour TV does not make an ideal computer monitor! Apart from a few technical deficiencies, the main property against it is simply its size. Analogue scanning at 625 lines is quite adequate for "Crossroads" at a distance of ten to twenty feet from the screen but leaves something to be desired when it sits ten inches from your nose. In spite of this, the characters are soon acceptable and the eyes quickly adjust to the new distance.

Colour And Screen Resolution

The ability to program graphics in full colour is an exhilerating experience. One of the demonstration tapes supplied produces a truly amazing pattern of shifting geometrical squares and triangles which never seems to repeat. In fact the program was so fascinating that further investigation of the system came to a halt for about an hour. Eventually, the hypnotic spell was broken and a return made to the programming of colour. The statement format is COLOR=n where n is a choice of 16. For example, 1=purple, 3=pink, 7=orange etc. etc. Note that the American spelling is mandatory in the BASIC command and applies only to "Low-resolution" graphics which has a screen resolution of 40 x 40 with four lines of plain text at the bottom of the graphics area. For finer detail, the "High-resolution" mode can be entered by the statement HGR. The resolution here is 360 x 160 giving an impressive total of 57,600 plotting points with room for four rows of text beneath. Providing you have at least 24K of RAM on board, there is an even higher resolution available by using HGR2. This gives a 360 x 192 resolution over the entire screen, allowing 69,120 plotting points. It is in this area that the PET becomes a poor relation to the 2020. A sine wave plotted on the PET is just a jagged mass of zigzag steps. On the 2020, it is almost equal to an oscilloscope trace.

There are one or two little snags however when on high resolution. There are only 7 colours available and these are almost unpredictable. In fact, the colour you get depends more on the plotting co-ordinates than the programmed colour. A curved line takes on a rainbow hue as it runs across the tube due simply to the PAL TV system finding itself unable to cope with the abrupt digital changes. The bandwidth is just not good enough to handle the situation. This is

not the fault of the 2020 but is simply a case of incompatibility which can only be finally resolved by installing a video monitor designed to the demanding standards of a rapidly changing logic output. However, one soon learns to accept the appearance and possibly with time, could even prefer the kaleidoscopic squiggles on the TV screen. The high resolution is a bonus that easily makes up for the loss of colour purity.

A neat little extra is provided in the form of a ferrite ring through which the aerial lead to the 2020 is threaded. This neat little dodge effectively traps the 50 Hz magnetic field and localises it to within a small area rather than throwing it around the four corners of the universe. It also provides a second order defence against the injection of mains spikes, glitches and similar acts of aggression. Summarising, the high-resolution capabilities are excellent, the colours are fascinating and the graphic characters are *as good as can be expected* from a commercial TV with r/f modulator input.

Cassette Tapes, Or Does It

The 2020 package includes a lead with a DIN outlet at one end and a couple of PHONO plugs at the other. By a fortunate coincidence, an oldish recorder was available described on the label as an ITT "SL58 super", had a DIN socket at the back with "automatic recording level" facilities and whose working life had previously been devoted to the occasional rendering of a Mike Jagger sonata.

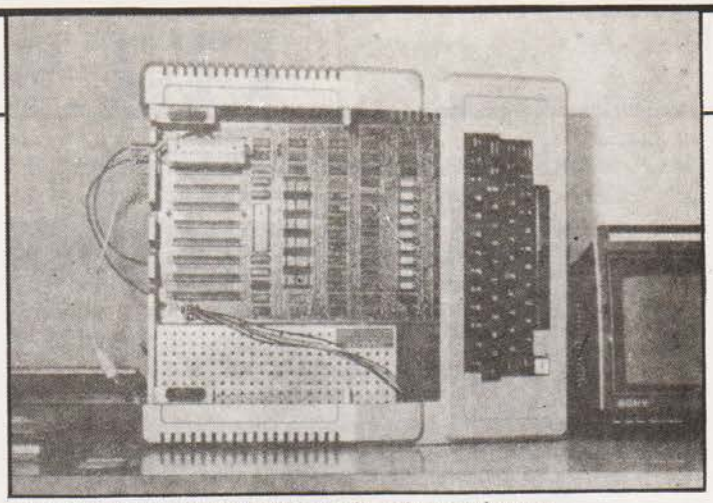
Perhaps the sudden honour of being responsible for filing computerised intelligence swelled the machine out with pride because it behaved impeccably in the first instance, loading and saving with an almost reckless abandon. This triumph was, sadly, short lived. The next evening, the wretch appeared to be in an unpleasant mood and often failed to load. It recovered spasmodically but at various times over the next few weeks it decided to sulk. Now there is no worse experience in the life of a home computer fanatic than the frightening possibility of losing a program which has probably taken a week to write and debug.

Everything is tried, including a purposeless adjustment of the volume control (even when you know the exercise is irrational because of automatic level). The sequel to this tale of woe was a happy one, it was just a poorly fitting socket in the phono input of the 2020. Apparently, modern technology can overcome the seemingly impossible feat of cramming about 30,000 semiconductors on to a small chip of silicon but can't seem to master the art of *reliably* mating one piece of metal with another.

Now although tape transfers are quite reliable, it becomes evident that the designers of the APPLE/ITT had not taken the idea of cassette storage very seriously. No doubt they assumed that anyone could afford an extra 400 pounds for a floppy disc. There is no provision for naming programs, no friendly advice from the screen telling you to "PRESS PLAY AND RECORD" etc (like the PET). In fact, the only help you get is an audible tinkle when the tape heading code is found and another when it is ended. Adequate I suppose but, after the PET, a little on the stark side. One advantage however is the speed of the tape transfer. The baud rate is substantially higher than the PETs and you are spared the almost interminably long period waiting for a few kilobyte program to load.

The Interior Furnishings

The case of the 2020 is clean, unobtrusive and constructed from some form of heavy, shock-resistant plastic. I still find it a miracle that such power and sophistication can be buried in such a small box. One advantage of being old is the ability to appreciate the avalanche of technology which has taken place over the last half century. Ten or more years ago, the power of the APPLE would have demanded a room full of massive floor-standing cabinets weighing several tons, equipped with expensive temperature and humidity controls and costing something around 40 thousand pounds. The younger generation will take the APPLE for granted, perhaps even grumble because it hasn't got a Pascal compiler in ROM!



An internal view of the 2020 revealing the neat layout.

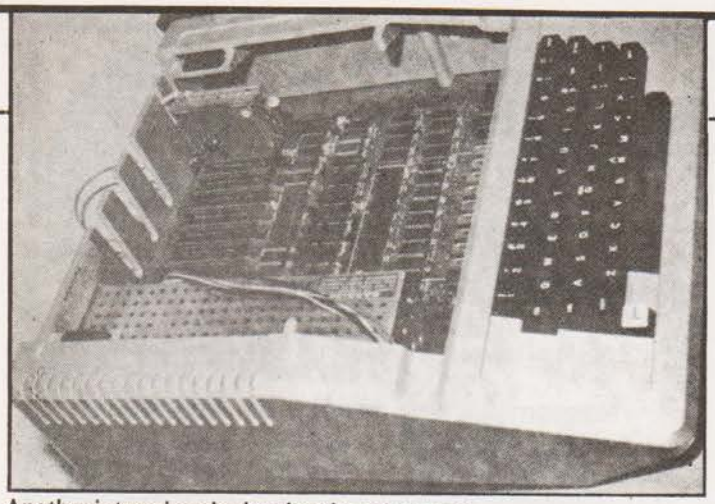
Back from nostalgia to the 2020 entrails. Snapping open the lid reveals one large mother board crammed with orderly arranged rows of RAM and ROM chips, the 6052 microprocessor and various TTL odds and ends. Occupying the left hand side is a long silvery box which houses the power unit.

The power available is adequate to supply not only the internal demands but also the eight possible peripheral interfaces which can be inserted in the rear slots. These slots are high quality, multipin sockets arranged at the back and designed to serve a wide range of add-ons. There are 50 pins on each, carryin gthe A0 to A15 address wires, D0 to D7 data wires, reset, address-select, powerlines etc etc. In addition to these eight peripheral slots, there is also a 16 pin DIP socket which has been primarily supplied to provide various game devices, switches, lamps, paddles etc. It can also be used to drive a serial device such as a teletype or printer, through suitable current buffers. As previously mentioned, a small loudspeaker is built in delivering about 0.5 watts of audio power which is ample for the emission of whistles and other signals which you may wish to provide under program control.

Keyboard

This has the standard QWERTY layout with the numerics on the top row (there is no separate numeric pad). Unlike the PET, there are no pretty little lines, blobs, corners or other graphical signs which PET users are accustomed to expect. The experienced tough typist would feel immediately at home. The feel is good and is extremely quiet. I found the editing facilities a little awkward after the PET. For example, there is no UP/DOWN cursor key; instead, the procedure is to hold the "ESCAPE" key down whilst pressing, then releasing another key. To delete, a character, one has to LIST the line first and run the cursor over all the characters within the statement number. Fortunately, there is a fast acting "REPEAT" key which soon scurries along over the characters so it is not too bad. It may be of course simply a case of "the best keyboard system is the one you are used to!".

The indication of POWER-ON is an illuminated pad at the front of the keyboard. I wonder why manufacturers always position the power switch at the back? It is slightly irritating to fumble around with the fingers before finding



Another internal angle showing the colour card.

the wretched thing. After all, the power consumption of most home computers is less than a 60 watt bulb so it would surely be possible to position a small switch at the front.

The BASIC Language

For all practical purposes, the version of floating point BASIC (PALSOFT II) in the 2020 is the same as the PETs, but . . and it's a big but . . with some very powerful extras. Most of these are concerned with the low and high resolution graphic facilities which will be discussed last. In the meantime, some of the other useful little extras are worth mentioning. If we type SPEED=n (where n is any number between 0 and 255) we can control the rate at which characters are printed onto the screen.

It is a strange thing but even highly intelligent people, when confronted with a keyboard and a VDU screen often seem to lose comprehension. They read the message but it doesn't sink in, probably because of "instantaneous" presentation of a page at a time. With say, SPEED = 50, the characters appear in orderly progression and the eye seems to lock-on to the brain at the same speed. Another advantage of the speed function is during a program LISTING. The usual scrolling rate (which appears to be at the speed of light) is too fast to "capture" the particular bit you want, it's gone before you have time to stop it. A nice leisurely scrolling speed is a real pleasure to use during a bout of debugging. It may be argued of course that even without the SPEED=n facility, it is easy to set up a FOR/NEXT loop to provide a brake on the printing speed but what a nuisance each time?

Another useful addition is the TRACE command which remains in operation until cancelled by a NOTRACE. The display prints out the line number of statements as they are executed which is of great use in following the progression of branch decisions and subroutines.

FLASH is another handy little dodge for calling attention to a particular part of the screen (the text alternates rhythmically between normal and reverse display). STORE x stores a numeric array x on tape and RECALL x loads the array back again. ONERR GOTO x provides a means of overriding the natural tendency of the machine to come to a sudden halt whenever it detects even the most trivial fault. Often, when confronted with one of the cursed error messages in BASIC, you feel like saying, "Iknow that you idiot, but carry on for the moment and I shall fix this later in my own time". The ONERR facility allows the machine to jump to a routine which handles the situation. RESUME causes a return to the offending statement.

Drawing Pictures

Just because the 2020 doesn't have a set of "Graphic" characters at the keyboard it doesn't mean space craft, submarines or geometrical structures cannot be drawn. In fact far more detailed drawings can be attempted (of almost any structure) but unfortunately at a certain cost in intellectual energy. The procedure is based on a set of machine code bytes called a SHAPE TABLE. The required shape is first drawn on graph paper in the form of small arrows indicating the linear path of the final shape. This graph is then translated into 8 bit patterns, converted to hexadecimal and stored as data bytes in a suitable memory block. Once stored, and the starting address noted, the shape can be displayed on the screen by the simple expedient of writing DRAW n at x,y where n is the drawing number (there can be many) and x,y are the coordinates at which you desire the drawing to commence. Some truly remarkable tricks can now be done with your shape. ROT = n will actually rotate the drawing clockwise by an angle dependent on the value of n.

To blow up the size of a drawing, the command SCALE = n is used where n is the scaling factor desired (n=1 to 255). After the initial fumbling period is over, these facilities can work miracles on the TV screen. Imagine for example the effect of manipulating even a simple triangle with random draw, rotate and scale within a FOR/NEXT loop with random colour thrown in for good measure. The effect is truly hypnotic.

Shape tables can be stored on tape by using a machine code routine Write and reloaded by a BASIC command SHLOAD.

Available Peripherals

The APPLE has been around for some years so, as expected, there are a wide variety of well-tried peripherals available. Printers, floppy disc units, XY plotters, D/A converters, ad nauseum. Most of them are expensive. Without doubt, the most desirable item which opens entirely fresh horizons would be a floppy. Another useful bit of apparatus which appears to have possibilities is a contraption called a "Writing Table". As I understand it, it is possible to literally draw a shape table with a pen (a special electronic one of course). The result is transferred directly into hexadecimal machine bytes for subsequent display using DRAW n. There are of course boxes which enable conversations in "normal" speech to be carried out between man and machine although I must confess this fails to arouse any enthusiasm in me. We often have difficulty in communicating effectively with each other so the chance of making a machine understand us appears to me a somewhat abortive exercise. A few 'Dalek' type monosyllables are all very well as a gimmiky laugh but it is doubtful if modern gobbledegook like". .the house is unable, at this point in time, to consider the implementation of para 4b of the Foods and Drugs Act until the present economic climate has strengthened" would make much sense to an APPLE, however much was spent on the interface.

The Economics

It is unnecessary to state the prices of the APPLE/ITT in actual figures because the current orgy of price fluctuations would render facts and figures out of date. It is relative prices which are important. The price of the APPLE/ITT 2020 has spiralled downwards faster than the PET to such an extent that no longer is the comparison unrealistic. The firm of COMMODORE must do something about it or they will be in danger of their markets being invaded by that small grey plastic box.

To sum up, I am still very happy with my PET but not quite so happy as I would have been had I never operated an APPLE.

Credits: Our thanks are due to the Byte Shop. Tottenham Court Rd., for the loan of an ITT 2020 for photographs.

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SOFTSPOT

W.H.Davies

This short program written in TRS–80 Level II BASIC enables the user to calculate the cost of his/her domestic gas consumption at any time during the quarterly period. It takes account of the latest price increases and will provide an additional check on the official account.

The program is self-prompting and easy to use in addition, it is quite easily altered to take account of future price changes.

Program Notes

In its present form the program is written for both types of consumer, those who budget by paying a set monthly sum to the gas board, and those who prefer to pay the bill as and when it arrives. In the latter case the user would answer the prompt 'enter credits carried forward' by entering 0.00.

A program listing, followed by a sample run, is given below.

PROGRAM LISTING

```
100 CLS PRINT
120 PRINT " *****   GAS ACCOUNT   ***** "
140 PRINT
160 PRINT
180 PRINT INPUT"ENTER CURRENT METER READING ";R
200 PRINT INPUT"ENTER PREVIOUS METER READING ";P
220 C = R - P
240 T = (C * 1027)/1000
260 PRINT"GAS SUPPLIED (THERMS) THIS QUARTER = ";T
280 H = 52
300 L = T - 52
320 X = H * 24 6
340 Y = L * 16 5
360 X=INT(X*100+ 5)/100 Y=INT(Y*100+ 5)/100
380 PRINT USING"CHARGES THIS QUARTER= #### ## ";((X+Y)/100)+2 16
400 PRINT"                (INCLUDES 2 16 STANDING CHARGE) "
420 PRINT
440 PRINT INPUT"ENTER CREDITS CARRIED FORWARD ";S
460 PRINT INPUT"ENTER DEBITS CARRIED FORWARD ";D
480 PRINT INPUT"ENTER CREDITS THIS PERIOD ";M
500 S=INT(S*100+ 5)/100 D=INT(D*100+ 5)/100 M=INT(M*100+ 5)/100
520 B = (((X+Y)/100)+2 16) - (M+S-D)
540 B=INT(B*100+0 5)/100
560 IF (((X+Y)/100)+2 16) < (M+S-D) GOTO 580 ELSE 620
580 PRINT USING"CURRENT CREDIT CARRIED FORWARD = #### ## ";-B
600 GOTO 999
620 PRINT USING"CURRENT DEBIT CARRIED FORWARD = #### ## ";B
999 END
```

SAMPLE RUN

```
ENTER CURRENT METER READING ? 4476

ENTER PREVIOUS METER READING ? 4103
GAS SUPPLIED (THERMS) THIS QUARTER =  383 071
CHARGES THIS QUARTER=   69 58
              (INCLUDES 2 16 STANDING CHARGE)


ENTER CREDITS CARRIED FORWARD ? 27 13

ENTER DEBITS CARRIED FORWARD ? 0 00

ENTER CREDITS THIS PERIOD ? 30 00
CURRENT DEBIT CARRIED FORWARD =   12 45
READY
>_
```

SPECIAL OFFER

ELECTROSTATIC PRINTER

Ask most people what they would like as their first peripheral and the chances are they will say "Printer". Well, thanks to CT, we are being generous this month, here is an attractive electrostatic printer from the famous firm of Centronics. Capable of printing in three sizes of typeface it is easily attached to your machine by way of the parallel interface. The logic is fully TTL compatible and STROBE, Acknowledge and Busy lines are provided to make life easy.

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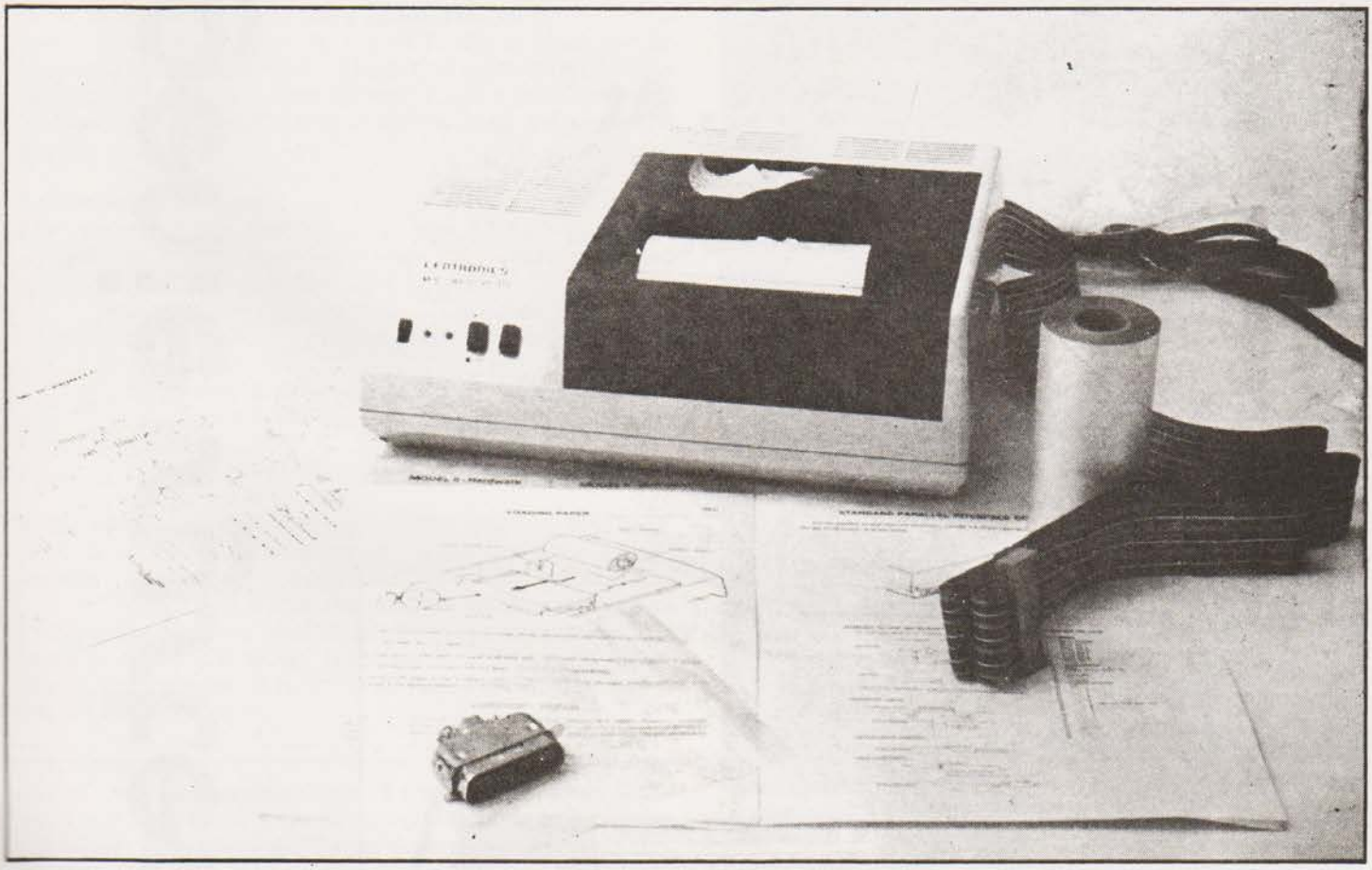
Don't miss out, be the first on your street with your own printer and then you can send us that latest program all neatly typed out!



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TRADE ENQUIRIES WELCOME

Elaine Douse

HOME FINANCE

Has the milkman had the paperboy's money again this week? If your home finances have run amok try this program.

This program was developed in order that a 'domesticated' 8K PET would look after the household finances. It could be adapted by the one man business or entertainer to keep track of spending against budgeting.

Although written for the PET, this program can be converted into most BASIC dialects that have string handling facilities. The graphics routines may cause a problem, these routines could be replaced by a conventional alpha-numeric display.

Accounting For Oneself

The concept of the program is to have 17 running budget accounts, (gas, food, spending money etc.), that are injected with a declared monthly allowance.

Money drawn against a budget is actioned as follows:-

a) Amount is deducted from appropriate budget with the new total being displayed.

b) Money is deducted from the monthly 'status' account with a warning if you have gone in the red.

c) Deduction from bank account with a warning if you are in the red.

If the savings account is being handled, then the first operation is modified in that money is put into the savings account.

The facilities within the program are shown in Figure 1, this being a typical photograph of the screen display. The access to the 'Initial set-up' is mainly to assist in any debugging of the program. It is, in actual fact, a subroutine used if you are on the first run.

Data Or Input

One of the main considerations of the program, when it was being written, was to allow complete flexibility in setting up the budget names and allowances during a program run. It's all very well having DATA statements which take up valuable memory, but the PET has a nasty habit of losing all stored variables if any part of the program is altered.

Setting Up The Program

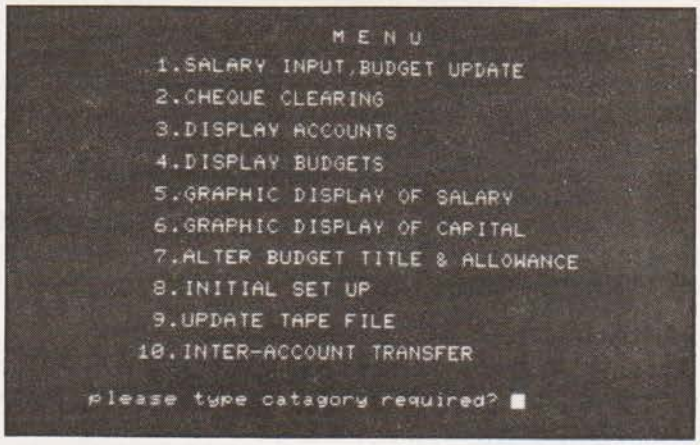
Once the listing is entered there are a few 'customising' lines that must be dealt with :-

Line 10 : This line must be set up with your own security password. Beware, if you type the password incorrectly during a program run, you will lose the whole program.

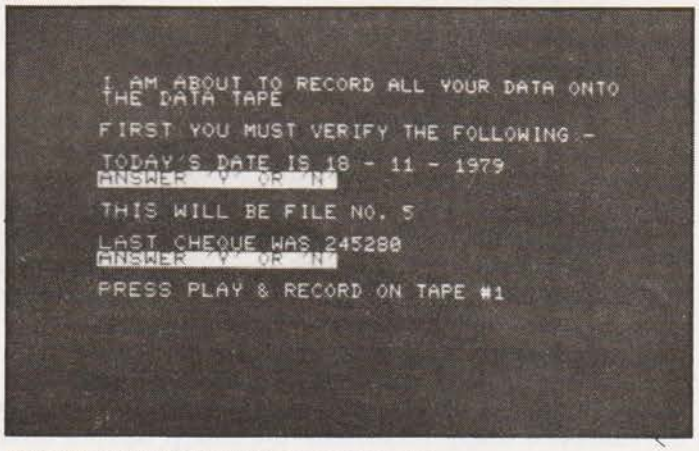
Lines 1280 : These lines have to be filled with your standing
4220 orders, direct debits etc.

Lines 5000 : These lines cover the two routines that produce
to 6420 bar graphs of one's salary and total savings.
If the scales need altering the following alterations need incorporating :-

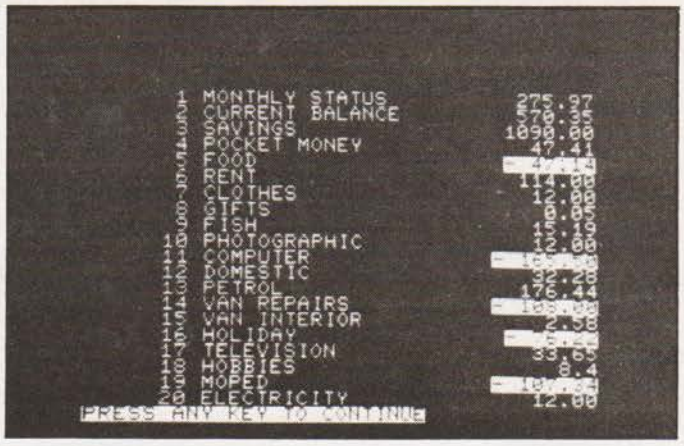
a)The print statements that display the scale and



The initial screen showing the available 'menu'.



A verification display prior to a tape update.



Budget listing. Note the leading and trailing zeroes with reverse graphics for overdrawn status.

left hand border will need rescaling.

b)The FOR . . . NEXT loops in lines 5300 and 6250 have to be set up in the following format FOR J = [MIN] TO [M%(I)] or [S%(I)] STEP [LINE SPACING]

Line 1220 : In declaring your take home pay, the computer will calculate your total savings, (total savings = savings + bank balance), and both savings and salary are stored for the month you are in. If your salary is paid in the next month then the subscript in lines 1160 and 1220 have to be altered. The subscript denotes the month number for the integer variables.

The Budgets

The program uses 20 'triplets' of subscripted variables and strings, namely,

T(1–20) This carries the budget totals.
B(1–20) The budget allowances are held here.
B$(1–20) These store the budget names.

The program can easily be modified to use more than 20 budgets but consideration must be made to the lines available on the screen display.

Up And Running

The first run should be used to set up the budget names and allowances. You will find the first three budgets are reserved and named as follows :-

BUDGET 1 – Monthly running total.
BUDGET 2 – Bank account status.
BUDGET 3 – Savings.

Don't be too worried at this stage in naming all the budgets or setting allowances. This, because of the flexibility of the program, can be settled at a later date.

It is wise at this stage to produce a data tape. If this is not done and a salary update is tried, then corrupt data will be transferred into the integer variables. This is due to the non existance of any date input. This only occurs at the tape dump and retrieval stage.

During your first data tape production the validation checks will show a date of 0-0-0. This should be corrected, also the last cheque number will read zero and this too can be put right during the program run.

Once the tape has been produced the program can be re-run. From here on all facilities are self explanatory during the run. As a safety precaution, the data is dumped twice. As long as the data was read in correctly and the tape is not moved during the program run, the second dump will be written over at the next dump.

PET Peculiarities

The PET's mathematics are not that hot, at least not on the author's. An example is :-

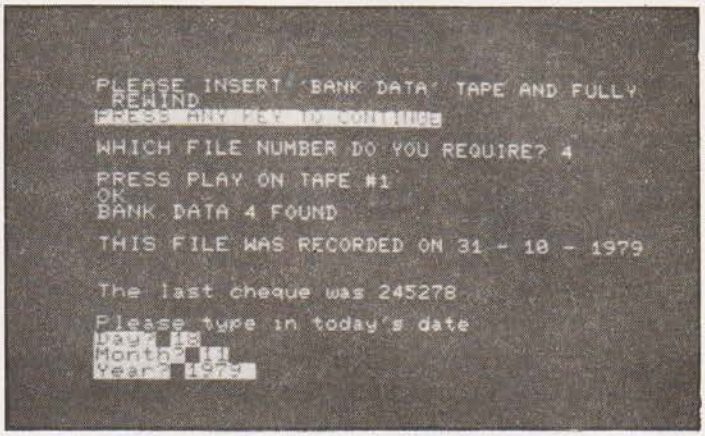
10.1 – 10 = .10000001

This, at times, has an irritating effect on the leading and trailing zeros and decimal point alignment when displaying the budget totals or allowances. It is not a common occurence, but, is slightly irritating when it happens. Maybe another reader has solved the problem?

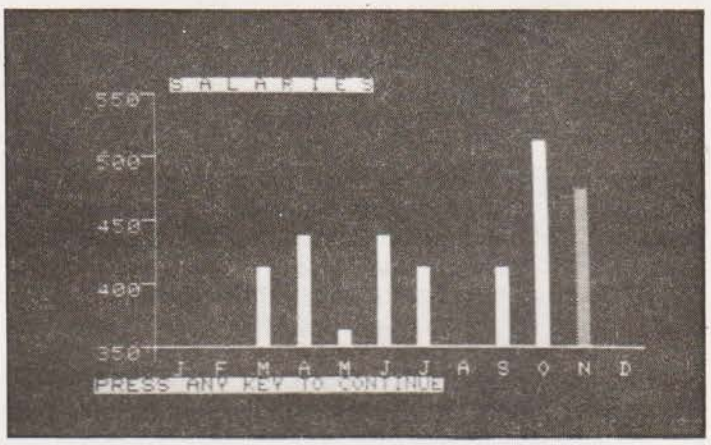
Listing Notation

All parts of the program listing that are enclosed by square brackets are instructions :-

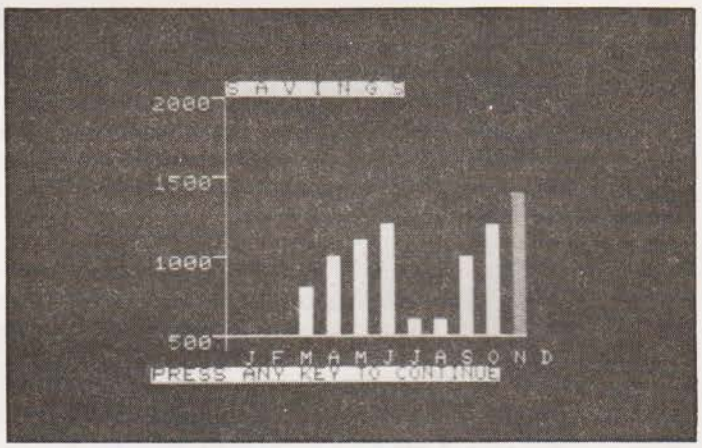
PASSWORD	Your particular word or number
STANDING ORDERS	Total standing orders
CLR	Clear VDU display



Data loading. Note the last cheque details and date.



The salary graph. Scales may be altered to suit.



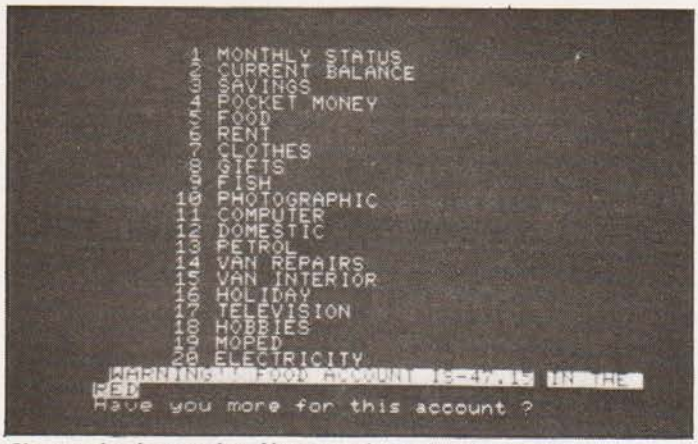
Saving graph. Scales can be adjusted, current month uses different graphics.

R	Revers graphics on
4 x CU	Four cursors up
?	PET shorthand for 'PRINT on VDU screen'

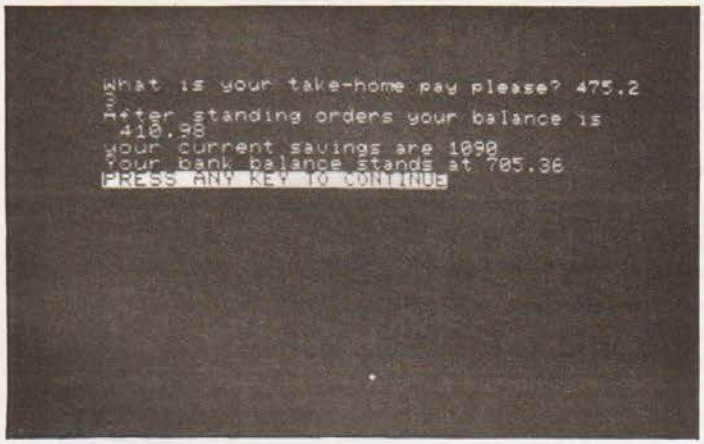
Post Script

A method to eliminate the mathematical 'problem' has been given to me during a phone call to Microdigital. It has not been included in the program due to the lack of time available. There is room left in the program to accommodate this. Here it is :-

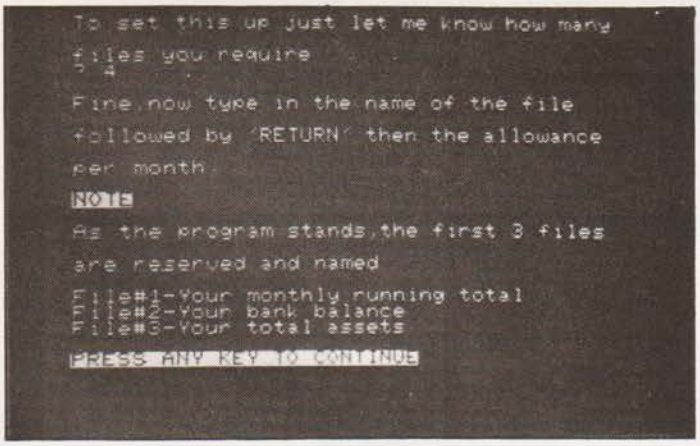
After a calculation, either by subroutine or dotted around



Cheque clearing routine. Note overdrawn budget display.



Monthly standing orders must be set up. See text for details.



Initial setting up display.

the program, the following format.
VARIABLE JUST ALTERED = INT(VARIABLE JUST ALTERED X 100) / 100
This works quite well except when subtraction has occurred. The 'nasty' that can happen then is something like 1.59999999 instead of 1.6. It will then seem not to be able to subtract as the answer, after the subroutine will give 1.59.

```
 5 INPUT"[CLR] PASSWORD PLEASE [R]"; A$
10 IF A$ <> "[PASSWORD]" THEN NEW
15 DIM B$(20), B(20), T(20), M%(12), S%(12)
20 ?"[CLR]" TAB(7) " BANK ACCOUNT–HOME
   FINANCE
30 ?TAB (19) "[CD] BY
40 ?TAB (14) "[CD] ELAINE DOUSE
50 FOR I=1 TO 3000:NEXT:POKE 59468,14
70 ?"[CLR] Is this a new program?
80 GOSUB 810 : IF R$ = "Y" THEN 8000
90 GOSUB 9500
100 ?"[CLR]" TAB(17) " M E N U
110 ? TAB(4) "[CD] 1. SALARY INPUT, BUDGET
    UPDATE
120 ?TAB(4) "[CD] 2. CHEQUE CLEARING
130 ?TAB(4) "[CD] 3. DISPLAY ACCOUNTS
140 ?TAB(4) "[CD] 4. DISPLAY BUDGETS
150 ?TAB(4) "[CD] 5. GRAPHIC DISPLAY OF
    SALARY
160 ?TAB(4) "[CD] 6. GRAPHIC DISPLAY OF
    CAPITAL
170 ?TAB(4) "[CD] 7. ALTER BUDGET TITLE AND
    ALLOWANCE
180 ?TAB(4) "[CD] 8. INITIAL SET–UP
190 ?TAB(4) "[CD] 9. UPDATE TAPE FILE
200 ?TAB(3) "[CD] 10. INTER ACCOUNT TRANSFER
210 INPUT "[CD.CD] Please type category required";R
220 IF INT(R) <> R THEN 100
230 IF R < 1 OR R > 10 THEN 100
240 ON R GOTO 1000, 2000, 3000, 4000, 5000, 6000,
    7000, 8000, 9000, 10000
250 GO TO 100
800 ?"[R] PRESS ANY KEY TO CONTINUE
810 GET R$ : IF R$ = " " THEN 810
820 RETURN
1000 ?"[CLR] DATA WILL BE DESTROYED IF I
     CONTINUE
1020 ?"[CD] Are you happy for me to proceed?" :
     GOSUB 810
1060 IF R$ <> "Y" THEN 100
1160 M% (N2) = T(2) + T(3)
1220 INPUT "[CLR] What is your take-home pay please";
     T(1) : S% (N2) = T(1)
1280 T(1) = T(1) – [STANDING ORDERS] : T(2) = T(2)
     + T(1)
1300 ?"[CD] After standing orders your balance is" : ?
     T(1)
1340 ?"[CD] Your current savings are" : ? T(3)
1360 ?"[CD] Your bank balance stands at" : ? T(2)
1380 GO SUB 800
1400 FOR I = 1 TO 20 : T(I) = T(I) + B(I) : NEXT : GO
     TO 100
2000 ?"[CLR]
2020 FOR I = 1 TO 20 : GOSUB 15000 : ? : NEXT
2040 INPUT "Which file do you require" ; R
2060 IF R < 1 OR R > 20 THEN 2040
2080 GOSUB 2900 : CH = CH + 1
2100 ?"Cheque No. "CH" please type in amount
2120 INPUT R1
2140 T(2) = T(2) – R1 : T(1) = T(1) – R1
2160 IF R <> 3 THEN 2220
2180 T(3) = T(3) + R1
2200 GOSUB 2900 : GOTO 2240
2220 T(R) = T(R) – R1 : GOSUB 2900
2240 IF T(2) >= 0 THEN 2280
2260 ?"[R] WARNING BANK BALANCE IS "T(2)"
     IN THE RED
2280 IF T(1) >= 0 THEN 2320
2300 ?"[R] WARNING MONTHLY BALANCE IS "T(1)"
```

```
    IN DEBT
2320 IF T(R) < 0 THEN 2360
2340 ?"YOUR" B$(R)" ACCOUNT STANDS AT "T(R) :
    GO TO 2380
2360 ?"WARNING!! " B$(R) " ACCOUNT IS "T(R)" IN
    THE RED
2380 ?"Have you more for this account?
2400 GOSUB 810
2420 IF R$ = "Y" THEN 2080
2440 GOSUB 2900
2460 ?"Have you any more cheques to clear ?" : GOSUB
    810
2480 IF R$ = "Y" THEN 2000
2500 GOTO 100
2900 ?"[HOME] 21 x [CD]" ;
2910 FOR I = 1 TO 119 : ? " " ; : NEXT
2920 ?"3 x [CU] 2 x [CR]" ; : RETURN
3000 ?"[CLR]" : FOR I = 1 TO 20 : GOSUB 15000
3110 T = INT(ABS(T(I))*100)/100 : A$ = STR$(T) :
    GOSUB 3800
3160 IF T(I) = > 0 THEN 3220
3180 ?"[R]" TAB(37 – LEN(A$)) " – " A$
3200 GOTO 3240
3220 ?TAB(38 – LEN(A$)) A$
3240 NEXT
3280 GOSUB 800 : GOTO 100
3800 IF T < > 0 THEN 3840
3820 A$ = "0.00" ; RETURN
3840 IF INT (T) < > T THEN 3880
3860 A$ = A$ + ".00" : RETURN
3880 IF INT (T*10) < > T*10 THEN 3920
3900 A$ = A$ + "0"
3920 IF T < 1 THEN 3960
3940 RETURN
3960 A$ = "0" + RIGHT $ (A$, LEN (A$) – 1)
3980 RETURN
4000 ?"[CLR]" : A = 0
4020 FOR I = 1 TO 20
4040 A = A + B(I)
4060 GOSUB 15000
4080 T = INT(ABS(B(I))*100)/100
4100 A$ = STR$(T)
4120 GOSUB 3800
4140 ?TAB(38 – LEN(A$)) A$
4160 NEXT
4200 ?"Your budget per month is" ;
4220 A = A + [STANDING ORDERS]
4240 T = INT(ABS(A)*100)/100
4260 A$ = STR$(T)
4280 GOSUB 3800
4300 ?TAB(38 – LEN(A$)) A$
4320 GOSUB 800
4340 GO TO 100
5000 POKE 59468,12
5010 ?"[CLR]    [R] SALARIES
5020 ?"550  |" : REM SHIFTED 'P'
5030 ?"     |" : REM SHIFTED APOSTROPHE
5040 ?"     |
5050 ?"     |
5060 ?"500  |
5070 ?"     |
5080 ?"     |
5090 ?"     |
5100 ?"450  |
5110 ?"     |
5120 ?"     |
5130 ?"     |
5140 ?"400  |
5150 ?"     |
5160 ?"     |
5170 ?"     |
5180 ?"350  | [36 x SHIFTED # ]
5190 ?"[6 SPACES] J [3 SPACES] F M A M J
    J A S O N D" : REM 3 SPACES BETWEEN EACH
    LETTER
5220 P = 33410
5240 FOR I = 1 TO 12
5260 B = 0
5280 P = P + 3
5300 FOR J = 350 TO S%(I) STEP 12.5
5310 IF S%(I) = < J THEN 5360
5320 IF I = N2 THEN 5400
5330 POKE P + B, 160
5340 B = B – 40
5360 NEXT J, I
5380 GOTO 5500
5400 POKE P + B, 102
5420 GOTO 5340
5500 GOSUB 800
5510 POKE 59468,14
5520 GOTO 100
6000 POKE 59468,12
6010 ?"[CLR]    [R] SAVINGS
6020 ?"2000 |" : REM SHIFTED 'P'
6030 ?"     |  : REM SHIFTED APOSTROPHE
6040 ?"     |
6050 ?"     |
6060 ?"     |
6070 ?"1500 |
6080 ?"     |
6090 ?"     |
6110 ?"     |
6120 ?"1000 |
6130 ?"     |
6140 ?"     |
6150 ?"     |
6160 ?"     |
6170 ?"500  | [24 x SHIFTED # ]
6180 ?"[6 x SPACE] J [SPACE] F M A M J
    J A S O N D" : REM SPACE BETWEEN EACH
    LETTER
6210 P = 33372
6220 FOR I = 1 TO 12
6230 B = 0
6240 P = P + 2
6250 FOR J = 500 TO M%(I) STEP 100
6255 IF M%(I) = < J THEN 6290
6260 IF I = N2 THEN 6300
6270 POKE P + B, 160
6280 B = B – 40
6290 NEXT J, I
6295 GOTO 6400
6300 POKE P + B, 102
6310 GOTO 6280
6400 GOSUB 800
6410 POKE 59468,14
6420 GOTO 100
7000 ?"[CLR]
7020 FOR I = 1 TO 20
7040 GOSUB 15000
7060 ?
7100 NEXT
```

```
7120 ?"Which account do you wish to change
7130 INPUT R
7135 IF R < 4 OR R > 20 THEN 7000
7140 IF INT(R) <> R THEN 7000
7150 Z$ = B$(R) : Z = B(R)
7160 INPUT "What is the new name" ; B$(R)
7180 INPUT "How much is its allowance" ; B(R)
7200 ?"[CD] [R] CHECK
7220 ?"Old "Z$" is now" B$(R)
7240 ?"[CD] And the allowance of "Z" is now" B(R)
7260 ?"[CD] [R] IS THIS CORRECT?
7280 GOSUB 810
7300 IF R$ = "Y" THEN 7350
7320 B$(R) = Z$ : B(R) = Z : GOTO 7000
7350 ?"[CD] Do you wishto lose this budget's
7360 ?"[CD] running total?
7380 GOSUB 810
7400 IF R$ = "Y" THEN T(R) = 0
7420 GOTO 100
8000 ?"[CLR] In this program you are allowed up to
8020 ?"[CD] 20 budget accounts
8040 ?"[CD] To set this up just let me know how many
8060 ?"files you require
8080 INPUT R
8100 IF R < 4 OR R > 20 OR R <> INT(R) THEN 8000
8120 ?"[CD] Fine, now type in the name of the file
8140 ?"[CD] followed by 'RETURN' then the allowance
8160 ?"[CD] per month
8180 ?"[CD] [R] NOTE
8200 ?"[CD] As the program stands, the first 3 files
8220 ?"[CD] are reserved and named
8240 ?"[CD] File #1 – Your monthly running total
8250 ?"File #2 – Your bank balance
8260 ?"File #3 – Your savings
8280 ?: GOSUB 800
8290 FOR I = 4 TO 20 : B$(I) = "SPARE" : NEXT
8300 B$(1) = "MONTHLY TOTAL"
8305 B$(2) = "BANK BALANCE"
8310 B$(3) = "SAVINGS"
8315 FOR I = 4 TO R
8320 ?"FILE #"I"        NAME          AMOUNT
8340 ?TAB(10) ; : INPUT B$(I) : ? "[CU]"
      TAB(30) ; : INPUT B(I)
8360 NEXT
8380 GOTO 100
9000 ?"[CLR] I AM ABOUT TO RECORD ALL YOUR
     DATA ONTO
9010 Z = 2
9020 ?"THE DATA TAPE
9040 ?"[CD] FIRST YOU MUST VERIFY THE
     FOLLOWING
9080 ?"[CD] TODAY'S DATE IS "N1" – "N2" – "N3
9100 GOSUB 9450
9120 IF R$ = "Y" THEN 9220
9140 GOSUB 9760
9220 F = F + 1
9240 ?"[CD] THIS WILL BE FILE NO. "F
9260 ?"[CD] LAST CHEQUE WAS "CH
9270 GOSUB 9450
9280 IF R$ = "Y" THEN 9315
9300 ?"[CD] [R] A N E W  B O O K !
9310 INPUT "[CD] WHAT WAS THE LAST CHEQUE
     NO." ; CH
9315 Z$ = "BANK DATA" + STR$(F)
9320 OPEN 1,1,2,Z$
9330 FOR I = 1 TO 20 : PRINT #1, B(I) : NEXT
9340 FOR I = 1 TO 20 : PRINT #1, T(I) : NEXT
9345 FOR I = 1 TO 20 : PRINT #1, B$(I) : NEXT
9350 FOR I = 1 TO 12 : PRINT #1, M%(I) : NEXT
9360 FOR I = 1 TO 12 : PRINT #1, S%(I) : NEXT
9370 PRINT #1, CH
9372 PRINT #1, N1
9374 PRINT #1, N2
9375 PRINT #1, N3
9380 CLOSE 1
9390 Z = Z – 1
9400 IF Z = 1 THEN 9320
9410 ?"[CLR] I HAVE FINISHED
9420 ?"[3CD] BYE BYE
9430 POKE 59468,12
9440 END
9450 ?"[R] ANSWER 'Y' OR 'N'
9460 GOSUB 810
9470 RETURN
9500 ?"[CLR] PLEASE INSERT 'BANK DATA TAPE
     AND FULLY REWIND
9540 GOSUB 800
9560 INPUT "[CD] WHICH FILE NUMBER DO YOU
     REQUIRE" ; F
9580 Z$ = "BANK DATA" + STR$(F)
9600 OPEN 1,1,0,Z$
9605 ?Z$ "FOUND
9610 FOR I = 1 TO 20 : INPUT #1, B(I) : NEXT
9620 FOR I = 1 TO 20 : INPUT #1, T(I) : NEXT
9630 FOR I = 1 TO 20 : INPUT #1, B$(I) : NEXT
9640 FOR I = 1 TO 12 : INPUT #1, M%(I) : NEXT
9650 FOR I = 1 TO 12 : INPUT #1, S%(I) : NEXT
9670 INPUT #1, CH
9672 INPUT #1, N1
9674 INPUT #1, N2
9676 INPUT #1, N3
9680 CLOSE 1
9740 ?"[CD] THIS FILE WAS RECORDED ON "N1" –
     "N2" – "N3
9750 ?"[CD] The last cheque was "CH
9760 ?"[CD] Please type in today's date
9770 INPUT "[R] Day" ; N1
9780 INPUT "[R] Month" ; N2
9790 INPUT "[R] Year" ; N3
9800 RETURN
10000 ?"[CLR]
10020 FOR I = 1 TO 20
10040 GOSUB 15000 : ?
10060 NEXT
10080 ?"[CD] From which file are you transferring
10100 INPUT "money" ; I
10120 IF I < 1 OR I > 20 OR I <> INT(I) THEN 10000
10140 ?"[CD] Into which file are you placing the
10160 INPUT "money" ; A
10180 IF A = I OR A < 1 OR A > 20 OR A <> INT(A)
      THEN 10140
10200 INPUT "And the amount please" ; R
10220 T(I) = T(I) – R : T(A) = T(A) + R
10240 ?"[CD] Have you any more transfers
10260 GOSUB 9450
10280 IF R$ = "Y" THEN 10000
10300 GOTO 100
15000 IF I > 9 THEN 15060
15040 ?TAB(5) I ; : GOTO 15080
15060 ?TAB(4) I ;
15080 ?TAB(7) B$(I) ;
15100 RETURN
```

R.Adams

MODEM PROJECT

Let micro talk to micro should be a buzz phrase of the Eighties. Use this project to join the leaders in home computing with your own modem.

One of the most popular items requested by readers in our survey last year was a modem. This is not the easiest of projects to produce and the delay has been caused by our waiting until a suitable design came in from outside. The unit is both simple in design, and hence easy to construct, and easy to use. Connection to the GPO telephone system is made accoustically, this is the only way to couple private computers at the moment because of the existing regulations.

The obvious advantages of being able to communicate over telephone lines are many; it's quick and easy, it's often cheaper-especially at high speed- than sending your program by post, and, in this case, it can be used by any micro which has a serial output. Imagine, with this project you'll be able to engage your trusty machine in all sorts of interesting games such as real-time chess with your friend down in Plymouth, play Star Trek with your works mainframe, or even use some of the on-line systems such as Prestel with a little software effort. Who ever said that conversation was a dying art?

Fig.1a. The tone frequencies used in Europe and America.

		US Standard		CCITT Standard	
Originate	Mark	1270 Hz	Chan. 1 Mark	980 Hz	
	Space	1070 Hz	Chan. 1 Space	1180 Hz	
Answer	Mark	2225 Hz	Chan. 2 Mark	1650 Hz	
	Space	2025 Hz	Chan. 2 Space	1850 Hz	

Needs To Be Met

The idea for this project was born out of a need to :

a) use a terminal to access a larger computer via my home telephone,
b) exchange software with other computer users by the same means,
c) send and receive TTY signals over the air in my capacity as a Radio Amateur.

Requirement (a) meant the use of modem tones in common use so as to achieve compatability with existing equipment.

Circuit Design

A look through the catalogue produced a Motorola integrated circuit which appeared to be capable of doing most of the work – the 6860. However, after a couple of days work I discovered that this particular IC catered only for the US standard tones. Back to Motorola who suggested their MC14412, which is the device now in use, *with an added bonus of being able to work on tones in use on both sides of the Atlantic.* The applications sheet which came with it gave me all the other information I needed.

Separate tones are generated for binary 0's and 1's applied at a serial data input terminal – modulation – and tones presented at the receive input are converted back to a serial data stream – demodulation.

Transmitted and received tones are also different thus permitting a Duplex link – simultaneous messages in both directions. Each end of a link must therefore be switched to opposite modes. (In the US these are called 'Originate' and

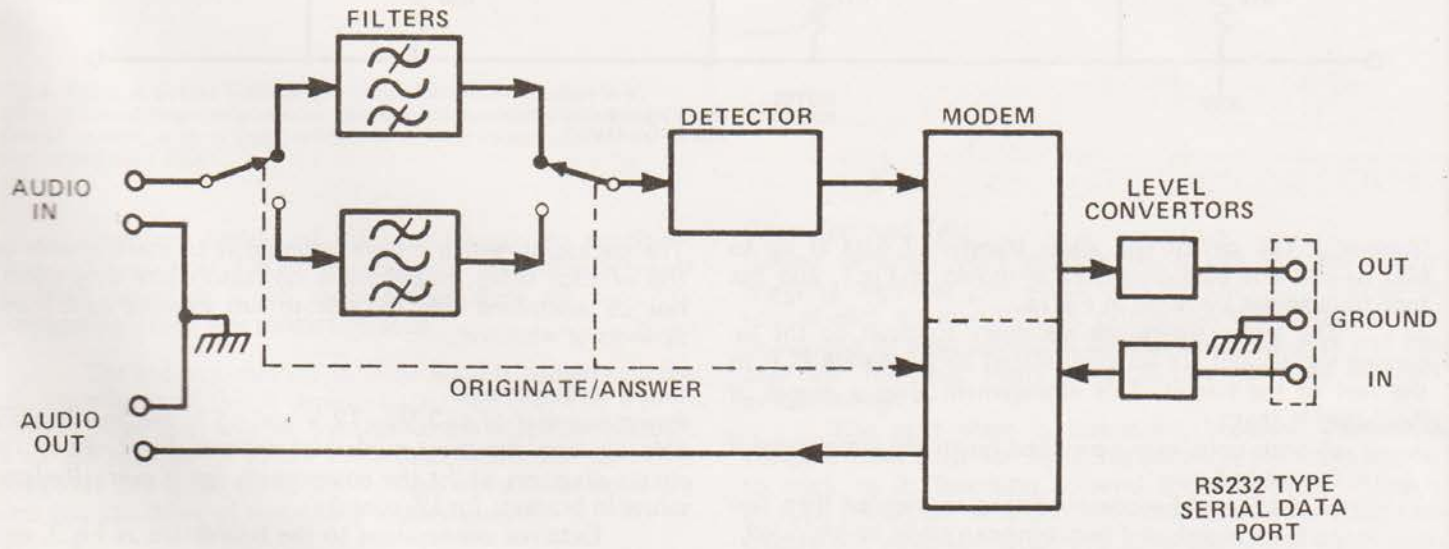


Fig.1. A block diagram of the modem system.

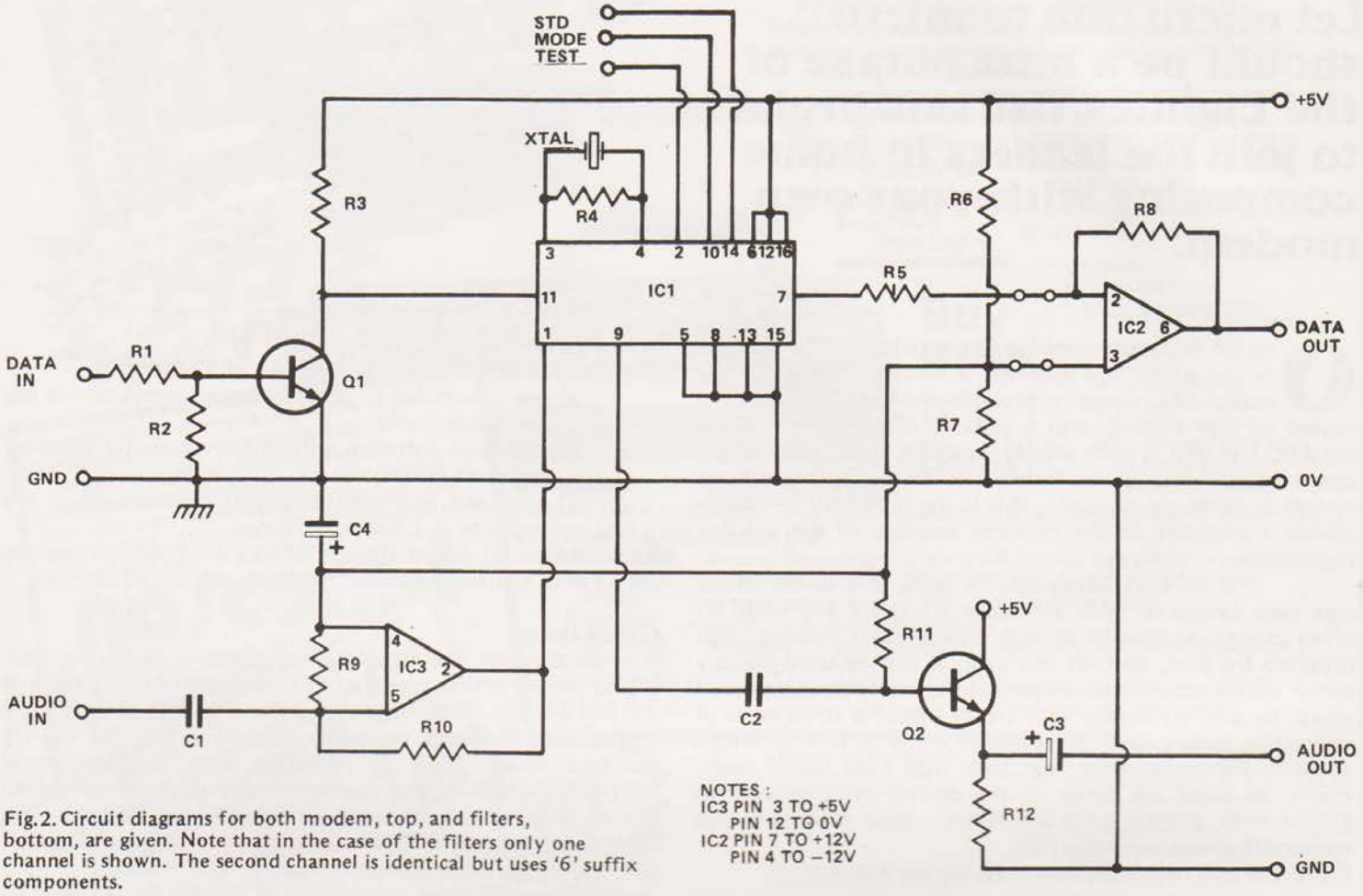
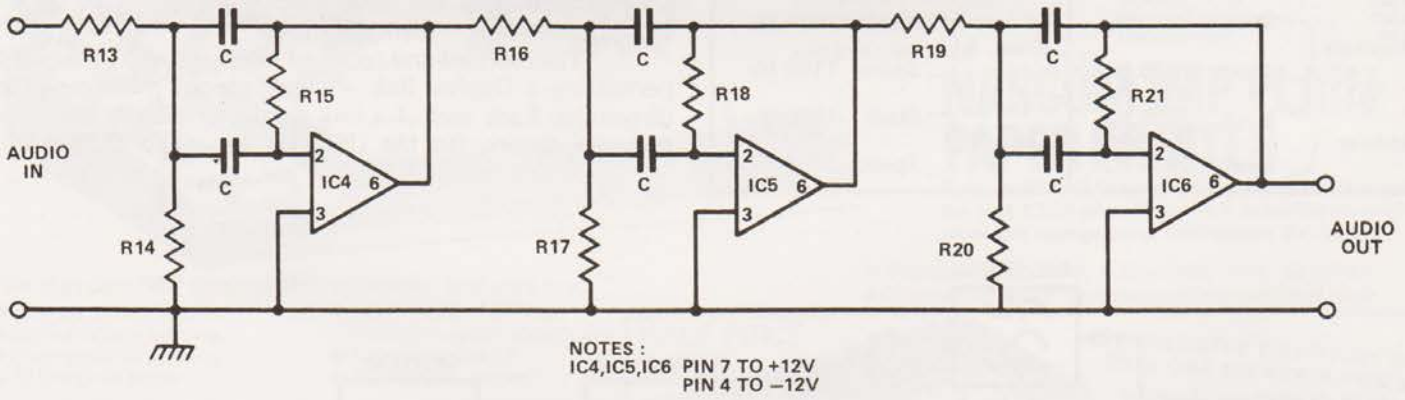


Fig.2. Circuit diagrams for both modem, top, and filters, bottom, are given. Note that in the case of the filters only one channel is shown. The second channel is identical but uses '6' suffix components.



'Answer'.) The circuit will allow transfer of data at up to 600 Bauds. The basic structure is shown in Fig.1. and the tone frequencies are listed in Fig.1a.

The audio filters are necessary to clean up the incoming signals and are accommodated on a separate PCB to the rest of the circuit. This arrangement gives a degree of flexibility in that :

a) both units may be etched on to the same board if required,
b) if US and European options are needed then two filter boards and switching can easily be provided,
c) other circuits – UART, Keyboard encoder etc. are under development on the same size PCB's.

The packaging which I have adopted is to stack boards on top of each other, but there is no reason why they should not be assembled side by side to suit existing card frame systems or whatever.

Power Requirements

Power supplies of +12 V, −12 V and +5 V are usually available on even the most modest of systems. Fig.2. shows the circuit diagrams whilst the components list is over. (Resistor values in brackets for US tones).

External connections to the boards are as Fig.3. and foil layouts for them, capable of being drawn easily with a pen, are shown in Fig.5.

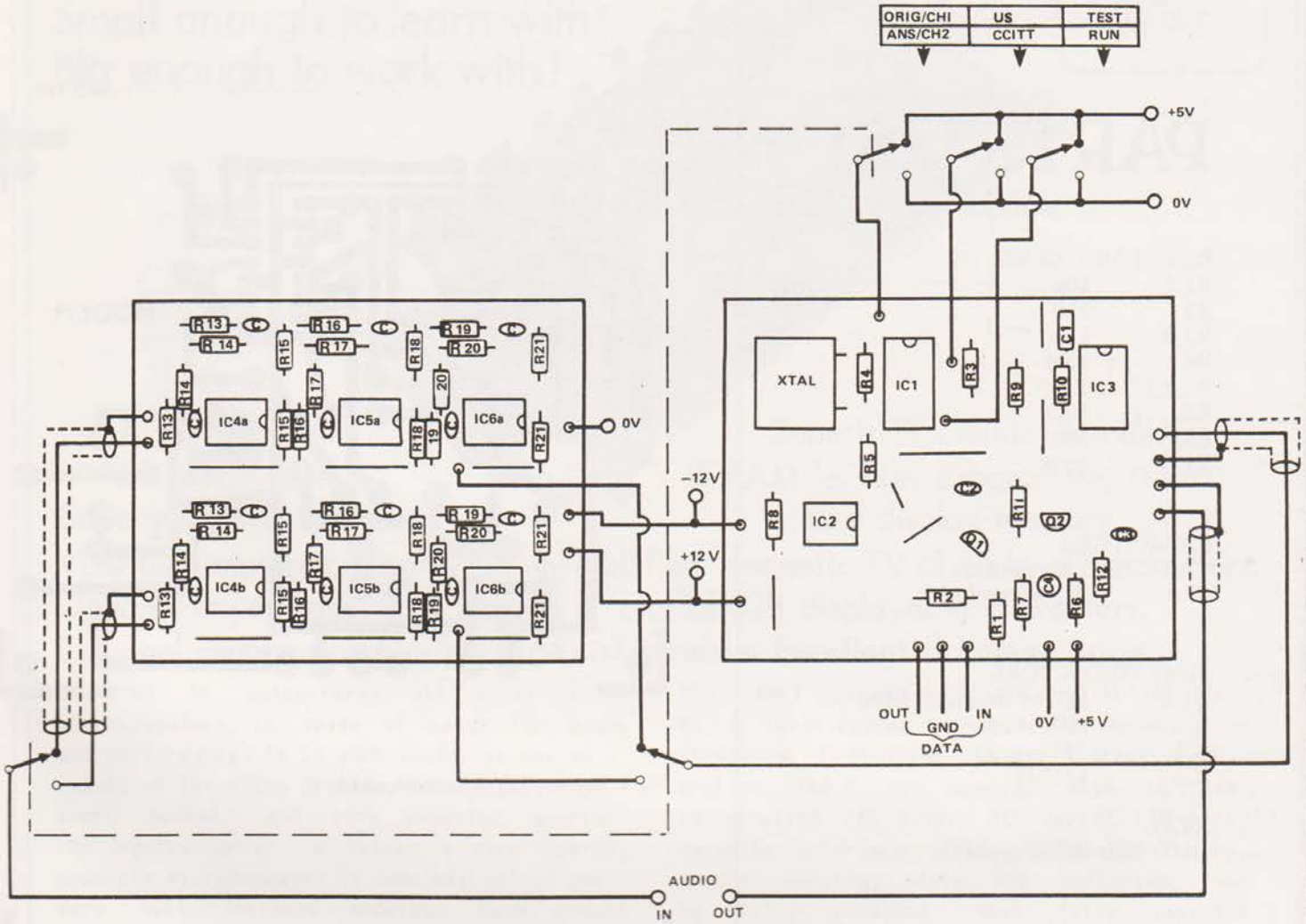


Fig.3. Above. This diagram shows the external connections required for the system and also gives the board overlay patterns. Top half components on the filter board are 'a' suffixed, bottom half are 'b' suffixed.

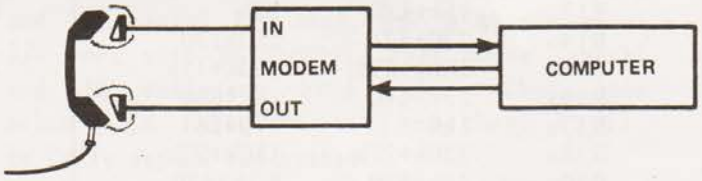


Fig.4. Right. A simple method of connection to the handset is by using old headphone earpieces as transducers. Accoustic isolation should be used, such as foam rubber, to prevent room noise corrupting your data.

Coupling devices of this sort directly to telephone lines requires Post Office approval of all the equipment involved, although I am assured that they are currently considering lifting this restriction soon.

The indirect method is to use what is known as acoustic coupling and this is demonstrated in Fig.4. The way in which I have been able to 'join on' to the telephone handset is to use sections of motor cycle innertube rolled up like a doughnut and glued on to the modem transducers but I am sure you can think of something equally quaint!

(A pair of 4000 ohm headphones was my source of transducers).

Operation And Test

Having switched your modem on it can be checked by selecting "self-test", in which case the OUT data should be echoed back to your VDU or printer. (A short program will be needed to push keyboard data to the serial port and display the incoming. Many monitors can call these facilities as subroutines.)

The next stage is interesting because, although a standard does exist for signalling polarity, few users appear to stick to it. Inversion of send and receive polarities is allowed for on the PCB and one could even fit another two changeover switches! Once you have discovered which standard polarity and mode of machine is on the other end of your link then off you go.

PARTS LIST

MODEM

RESISTORS All ¼W, 5%

R1,5	10k
R2	1k0
R3,9	12k
R4	15M
R6,7,12	1.8k
R8	100k
R10	1M0
R11	180k

CAPACITORS

C1,2	220n ceramic
C3,4	22u electrolytic

SEMICONDUCTORS

Q1,2	BC184 or similar NPN
IC1	MC14412
IC2	741
IC3	LM339

XTAL
1.000 MHz HC6U type

FILTER

RESISTORS All ¼W, 5%

R13a	18k+1.8k	15k
R14a	270+82	150+120
R15a	180k+39k	150k+15k
R16a	22k+270	18k+680
R17a	1k0	270+56
R18a	220k+27k	180k+27k
R19a	10k+470	8.2k+470
R20a	1.2k+220	470+150
R21a	100k+15k	68k+27k
R13b	10k+22k	15k
R14b	120+10	820+27
R15b	330k+12k	150k+15k
R16b	4.7k+33k	15k+6.8k
R17b	150+33	1.2k+39
R18b	390k+22k	180k+56k
R19b	6.8k+10k	8.2k+680
R20b	270+33	2.2k+330
R21b	150k+39k	100k

CAPACITORS
All 10n ceramic

SEMICONDUCTORS
All IC's type 741

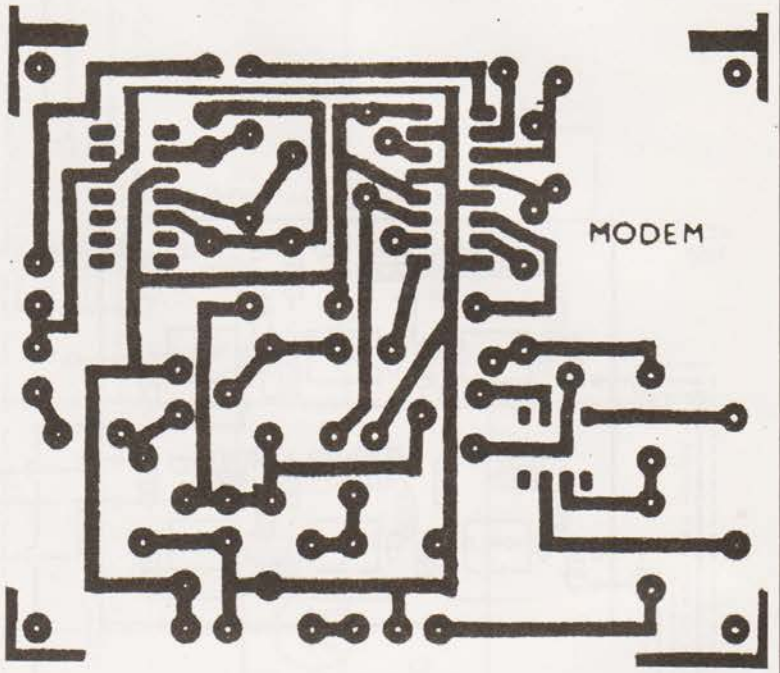
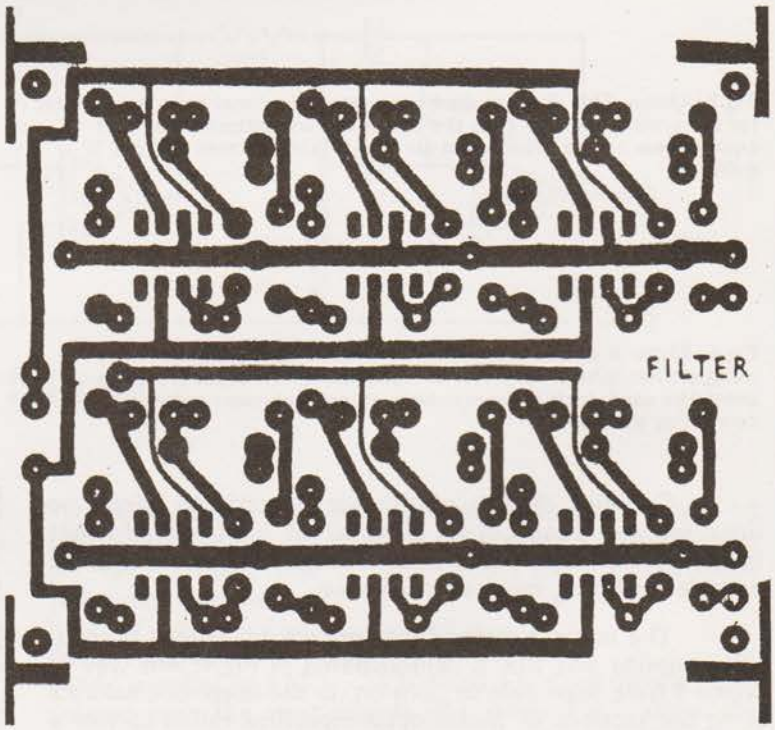


Fig.5. The two foil patterns required.



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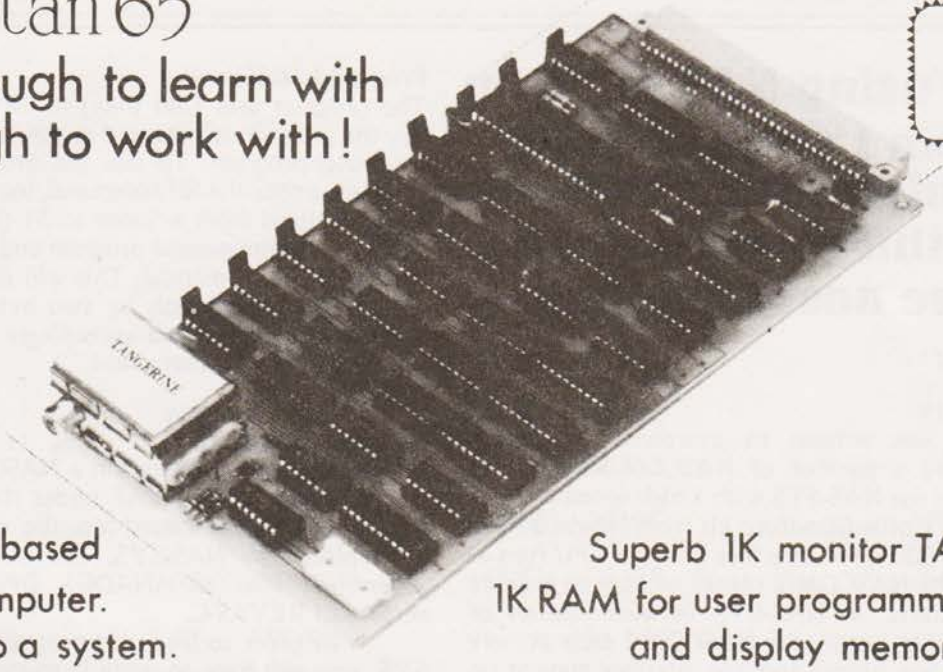

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TANGERINE

P.Fernley

If you are using NAS-SYS on the Nascom 1 and you want to use a high speed cassette interface this program will solve those nasty loading problems.

This program was written to overcome a problem experienced by a number of NASCOM-1 users who were trying to use NAS-SYS with a high speed cassette interface such as the Cottis-Blandford kit from Newbear. The NASCOM-2 uses a 1200 baud interface and the CPU runs at 4 MHz. This gives the NASCOM-2 plenty of time to execute the numerous 'Restarts' in NAS-SYS between receipt of bytes at the UART. However, the NASCOM-1 runs at only 2 MHz (unless you are lucky) and the interface runs at up to 2400 baud. Thus the NASCOM-1 is receiving data at the UART at four times the relative speed of the NASCOM-2 and unfortunately it cannot cope with this and a 100% read error rate can quite easily be achieved!

Program Location

The program uses C80 (hex) to CF9 (hex) inclusive. As set up, the program is executed as a NAS-SYS command and not as a user-program. To use the program as a normal user-program under the 'E' command, loction CE6 (hex) will have to be changed from a 'jump to 51 (hex)' to a 'call 51 (hex)' followed by the normal program end instruction as explained in the NAS-SYS manual. This will displace the remainder of the program backwards by two bytes and the 'CALLs' will have to be recalculated accordingly. Execution is from C80 (hex) using the 'E' command.

Software Operation

The program was written on a NASCOM-1 with 32K expansion memory using ZEAP under the T4 operating system. The program was tested on the same machine but with T4 replaced by NAS-SYS. The object code was then disassembled onto an ANADEX DP8000 using a modified version of REVAS-C.

In order to load this program from tape under NAS-SYS, you will have to write it to tape in the slowest format and speed available; for example the 240 baud standard NASCOM-1 format or the slowest CUTS format your interface can run at. In my experience this is a small price to pay for 2400 baud thereafter!

PROGRAM LISTING

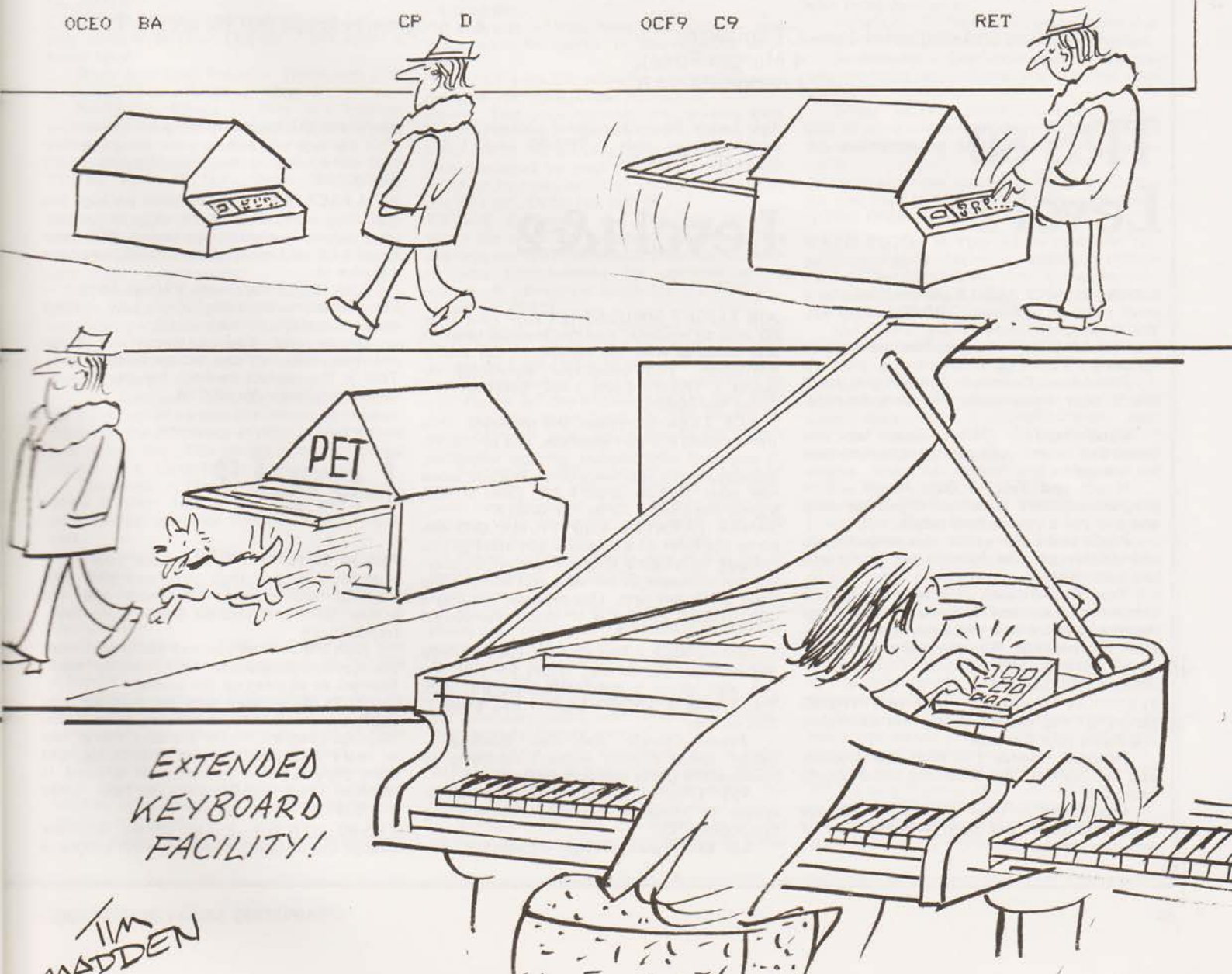
```
ADDRESS  OPCODE      LABELS  INSTRUCTION
                     L0051   EQU   £0051
                     L0081   EQU   £0081
                     L0088   EQU   £0088
                     L032D   EQU   £032D
0C80  CD 51 00               CALL  L0051
0C83  CD E9 0C       L0C83   CALL  L0CE9
0C86  FE FF          L0C86   CP    £FF
0C88  20 0D                  JR    NZ,L0C97
0C8A  06 03                  LD    B,£03
0C8C  CD E9 0C       L0C8C   CALL  L0CE9
0C8F  FE FF                  CP    £FF
0C91  20 04                  JR    NZ,L0C97
0C93  10 F7                  DJNZ  L0C8C
0C95  18 11                  JR    L0CA8
0C97  FE 1B          L0C97   CP    £1B
0C99  20 E8                  JR    NZ,L0C83
0C9B  06 03                  LD    B,£03
0C9D  CD E9 0C       L0C9D   CALL  L0CE9
0CA0  FE 1B                  CP    £1B
0CA2  20 E2                  JR    NZ,L0C86
0CA4  10 F7                  DJNZ  L0C9D
0CA6  18 3B                  JR    L0CE3
0CA8  CD E9 0C       L0CA8   CALL  L0CE9
0CAB  6F                     LD    L,A
0CAC  CD E9 0C               CALL  L0CE9
0CAF  67                     LD    H,A
0CB0  CD E9 0C               CALL  L0CE9
0CB3  5F                     LD    E,A
0CB4  CD E9 0C               CALL  L0CE9
0CB7  57                     LD    D,A
0CB8  0E 00                  LD    C,£00
0CBA  CD 2D 03               CALL  L032D
0CBD  CD E9 0C               CALL  L0CE9
0CC0  B9                     CP    C
0CC1  20 12                  JR    NZ,L0CD5
0CC3  43                     LD    B,E
0CC4  0E 00                  LD    C,£00
0CC6  CD E9 0C       L0CC6   CALL  L0CE9
```

NAS READ

```
OCC9  77              LD   (HL),A      OCE1  20 A0           JR   NZ,LOC83
OCCA  81              ADD  C           OCE3  EF        LOCE3 RST  £28
OCCB  4F              LD   C,A         OCE4  18 00           DB   £18, £00

OCCC  23              INC  HL          OCE6  C3 51 00  LOCE6 JP   L0051
OCCD  10 F7           DJNZ LOCC6       OCE9  E5        LOCE9 PUSH HL
OCCF  CD E9 OC        CALL LOCE9       OCEA  D5              PUSH DE
OCD2  B9              CP   C           OCEB  C5              PUSH BC
OCD3  28 06           JR    Z,LOCDB    OCEC  CD 81 00  LOCEC CALL L0081
OCD5  EF        LOCD5 RST  £28         OCEF  38 05           JR    C,LOCF6
OCD6  3F 20 00        DB   £3F,£20,£00 OCF1  CD 88 00        CALL L0088

OCD9  18 A8           JR   LOC83       OCF4  30 F6           JR   NC,LOCEC
OCDB  EF        LOCDB RST  £28         OCF6  C1        LOCF6 POP  BC
OCDC  2E 20 00        DB   £2E,£20,£00 OCF7  D1              POP  DE
OCDF  AF              XOR  A           OCF8  E1              POP  HL
OCE0  BA              CP   D           OCF9  C9              RET
```



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SPACE TREK IV Trade or wage war on a planetary scale. This package includes:

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You decide, guns or butter, with your TRS-80 Level II 16K. Order No. 0034R

RAMROM PATROL/TIE FIGHTER/KLINGON CAPTURE Buck Rogers never had it so good. Engage in extraterrestrial warfare with:

Ramrom Patrol – Destroy the Ramron ships before they capture you.

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CARDS This one-player package will let you play cards with your TRS-80 – talk about a poker face!

Draw and Stud Poker – These two programs will keep your game sharp.

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This package's name says it all. Requires a TRS-80 Level II 16K. Order No. 0063R

HOUSEHOLD ACCOUNTANT Let your TRS-80 help you out with many of your daily household calculations. Save time and money with these fine programs:

Budget and Expense Analysis – You can change budgeting into a more pleasant job with this program. With nine sections for income and expenses and the option for one- and three-month review or year totals, you can see where your money is going.

Life Insurance Cost Comparison – Compare the cost of various life insurance policies. Find out the difference in price between term and whole life. This program can store and display up to six different results.

Datebook – Record all those important dates in your life for fast, easy access. The program has all major holidays already included.

All you need is TRS-80 Level II 16K. Order No. 0069R

FINANCIAL ASSISTANT Compute the figures for a wide variety of business needs. Included are:

Depreciation – This program lets you figure depreciation on equipment in five different ways.

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1% Forecasting – Use this simple program to forecast sales, expenses, or any other historical data series.

All you need is a TRS-80 Level II 16K. Order No. 0072R

PET

CASINO I These two programs are so good, you can use them to check out and debug your own gambling system!

Roulette – Pick your number and place your bet with the computer version of this casino game. For one player.

Blackjack – Try out this version of the popular card game before you go out and risk your money on your own "surefire" system. For one player.

This package requires a PET with 8K. Order No. 0014P

CASINO II This craps program is so good, it's the next best thing to being in Las Vegas or Atlantic City. It will not only play the game with you, but also will teach you how to play the odds and make the best bets. A one player game, it requires a PET 8K. Order No. 0015P

CHECKERS/BACCARAT Play two old favourites with your PET.

Checkers – Let your PET be your ever-ready opponent in this computer-based checkers program.

Baccarat – You have both Casino- and Blackjack-style games in this realistic program.

Your PET with 8K will offer challenging play anytime you want. Order No. 0022P

MIMIC Test your memory and reflexes with the five different versions of this game. You must match the sequence and location of signals displayed by your PET. This one-player program includes optional sound effects with the PET 8K. Order No. 0039P

TREK-X Command the Enterprise as you scour the quadrant for enemy warships. This package not only has superb graphics, but also includes programming for optional sound effects. A one-player game for the PET 8K. Order No. 0032P

TURF AND TARGET Whether on the field or in the air, you'll have fun with Turf and Target package. Included are:

Quarterback – You're the quarterback as you try to get the pigskin over the goal line. You can pass, punt, hand off, and see the results of your play using the PET's superb graphics.

Soccer II – Play the fast-action game of soccer with four playing options. The computer can play itself, play a single player, two players with computer assistance, and two players without help.

Shoot – You're the hunter as you try to shoot the bird out of the air. The PET will keep score.

Target – Use the numeric keypad to shoot your puck into the hom position as fast as you can.

To run and score all you'll need is a PET with 8K. Order No. 0097P

ARCADE I This package combines an exciting outdoors sport with one of America's most popular indoor sports:

Kite Fight – It's a national sport in India. After you and a friend have spent several hours manoeuvering your kites across the screen of your PET, you'll know why!

Pinball – By far the finest use of the PET's exceptional graphics capabilities we've ever seen, and a heck of a lot of fun to play to boot.

Requires an 8K PET. Order No. 0074P

ARCADE II One challenging memory game and two fast-paced action games make this one package the whole family will enjoy for some time to come. Package includes:

UFO – Catch the elusive UFO before it hits the ground!

Hit – Better than a skeet shoot. The target remains stationary, but you're moving all over the place.

Blockade – A two-player game that combines strategy and fast reflexes.

Requires 8K PET. Order No. 0045P

DUNGEON OF DEATH Battle evil demons, cast magic spells, and accumulate great wealth as you search for the Holy Grail. You'll have to descend into the Dungeon of Death and grope through the suffocating darkness. If you survive, glory and treasure are yours. For the PET 8K. Order No. 0064P

Apple

MATH TUTOR I Parents, teachers, students, now you can turn your Apple computer into a mathematics tutor. Your children or students can begin to enjoy their math lessons with these programs:

Hanging – Perfect your skill with decimal numbers while you try to cheat the hangman.

Spellbinder – Cast spells against a competing magician as you practice working with fractions.

Whole Space – While you exercise your skill at using whole numbers your ship attacks the enemy planet and destroys alien spacecraft.

All programs have varying levels of difficulty. All you need is Applesoft II with your Apple II 24K. Order No. 0073A

MATH TUTOR II Your Apple computer can go beyond game playing and become a mathematics tutor for your children. Using the technique of immediate positive reinforcement, you can make math fun with:

Car Jump – Reinforce the concept of calculating area while having fun making your car jump over the ramps.

Robot Duel – Practice figuring volumes of various containers while your robot fights against the computer's mechanical man.

Sub Attack – Take the mystery out of working with percentages as your submarine sneaks into the harbor and destroys the enemy fleet.

All you need is Applesoft II with your Apple II and 20K. Order No. 0098A

GOLF Without leaving the comfort of your chair, you can enjoy a computerized 18 holes of golf with a complete choice of clubs and shooting angles. You need never cancel this game because of rain. One or two players can enjoy this game on the Apple with Applesoft II and 20K. Order No. 0018A

BOWLING/TRILOGY Enjoy two of America's favorite games transformed into programs for your Apple:

Bowling – Up to four players can bowl while the Apple sets up the pins and keeps score. Requires Applesoft II.

Trilogy – This program can be anything from a simple game of tic-tac-toe to an exercise in deductive logic. For one player.

This fun-filled package requires an Apple with 20K. Order No. 0040A

Owen Bishop

After flashing our LED's last month we take a look at how light can be used to trigger your micro's responses.

Last month we saw how the system could produce outputs at the I/O device ports or at one of the Flag terminals when instructed to do so by a program. This is capable of producing pretty effects with coloured lights, and thought it could sometimes be useful in letting you know which stage of a program has been reached, the output facility would be even more useful if it could be triggered in response to some *external* event. For example, the microprocessor would cause an alarm bell to sound when an intruder interrupts a beam of light. This may appear to be a rather unsophisticated application for our revolutionary micro-chip, an ordinary relay would do the job just as well. But this could be just a small part of a complete security system operating under microprocessor control. The complete system might incorporate not only light-beam intruder-detectors, but door-switches, pressure-pads, fire detectors, smoke detectors and so on; it might be switched off automatically during working hours; it might be transferred to reserve batteries in the event of mains power failure. For the moment, let us return to the simpler problem of how the system can be made to produce an output following a given input.

Acting In Response

Inputs are received by the I/O device, after lines have been designated as inputs, the way to program this is described later. The SC/MP also has two terminals *permanently* operating as inputs: these, SENSE A and SENSE B, give direct access to the MPU itself and their state is registered in bits 4 and 5 of status register. Programs for reading and using this information are given later.

As an example of the kind of input that a system might receive, we are taking a simple interface that responds to the amount of light falling on it. This device (Fig.1) gives high output at Output 1 when the phototransistor is in bright light, and gives a low output when light is low. Thought the light level may fade gradually, the switch-over from high to low level output takes place sharply. This is the effect of using Schmitt trigger gates (IC1); a further point is that with slowly falling light levels, the output will not change back again to high should there be a slight but temporary increase in the amount of light. A substantial increase is needed before output becomes high again. This action called hysteresis, is also found when light levels are increasing, and gives the interface a sharp snap-action when operating on borderline light intensities that may be fluctuating slightly. The effect of increasing the amount of light falling on the phototransistor is to increase the amount of current flowing through it from R2. As current increases, potential at point A falls, giving a low input to gate 1. This is a NAND logic gate wired as an INVERT gate, so its output then becomes high. With low light intensity, TR1 is almost switched off, potential at A is high, and the output of gate 1 is low. The output of gate 1 (output 1) may be used direct as an input to the microprocessor or I/O device. It is sometimes convenient to have an inverted output and this is obtained at no extra cost by using the other gate in the IC. Output 2 therefore goes low in high light, and high in low light.

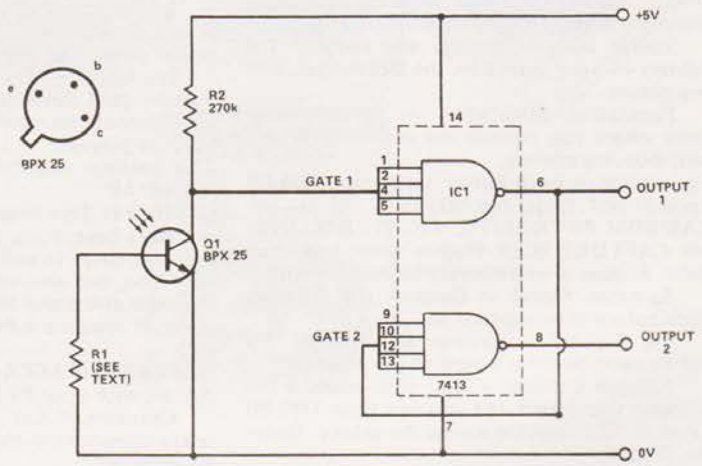

Fig.1. The circuit diagram for the light activated switch. A sensitivity control may be fitted (see text for details).

The exact level at which the change from high to low occurs depends on the value of R1. To operate under low-light conditions (dusk, dawn, moderate room lighting), R1 should be about 100 k. To operate under bright daylight, R2 should be about 10 M, or can even be omitted altogether. If you wish to set the interface to respond at a particular light level, use a 2 M variable resistor in place of R1.

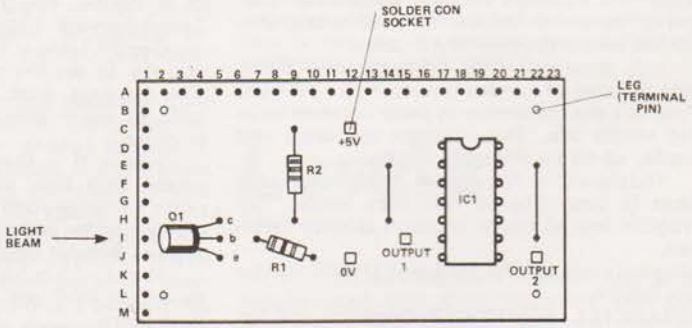

Fig.2. Veroboard layout for the interface unit.

Construction

Fig.2. shows the layout of the circuit board, and construction presents no problem. Soldercon pins were used as terminals in the prototype so that the device could quickly be connected in a variety of ways to other devices. If it is to be used as part of a permanent installation, these could be replaced by ordinary terminal pins. The legs (also made from pins) can be omitted if the board is to be permanently mounted in, say, a small case with a hole to admit a beam of

light. Although we often refer to a beam of light, there is no need to employ a beam as such.

In an alarm-system application the source of light can be a distant street-lamp, a room light, or a sunlit light-coloured wall The device will function whenever someone (or the cat!) passes between the source of light and the lens of the phototransistor. The lens makes the device fairly directional.

Detecting An Input

Program A shows how the state of SENSE A input to SC/MP may be monitored. The contents of status register are copied to accumulator and are then ANDed with 0001 0000. If bit 4 is low, the result is 0000 0000; if bit 4 is high, the result is 0001 0000. In the first even the program jumps back to examine the status again. In the second event it sets Flag 3 high causing an LED to light (assuming you have the LED interface connected). Note that this program causes a response when input goes high – when a light-beam is broken (if you use Output 2 of the interface), or when a light is shone on the phototransistor (if you use Output 1). Thus you can use this program to detect an intruder or the onset of dusk, or in the other sense you can use it to tell you when the headlamps of a car are approaching the house at night – or that the house is on fire! Programs B and C are variations on Program A, having different action when triggered.

The use of the INS8154 Input/Output is illustrated by programs D, E and F for the 6502 MPU, as used in Acorn. Programs for the same device in the Mk-14 microcomputer could operate along similar lines. The procedure for using this device for outputting data was described in last month's issue, and a table of addresses was given. To use this device for inputs we adopt a similar procedure.

1) Determine which lines are to be inputs and which are to be outputs.

This is done by making up a byte in which '0' represents 'input' and '1' represents 'output'. Thus the byte 1111 1110 means that all lines are to be outputs except line 0. If this byte is stored in output definition register B (0DB), which is at address 0923 in Acorn (0A23 in Mk-14), lines B1 to B7 of Port B become outputs and only B0 becomes an input. Similarly we could address a byte to 0DA (0922, 0A22) to determine the functions of the lines of Port A.

2) Read the input at a given line.

For SC/MP the instruction is 'load' followed by one of the bit addresses that are also used for setting or resetting outputs. For example, address XX0A means 'clear line B2' and address XX1A means 'set line B2' when we are working with outputs. When a line has been designated as an input we can use *either* 'load XX0A' *or* 'load XX1A' when we want to read the value at the B2 input. With SC/MP the accumulator then contains either 0000 0000, if the input was low, or 1000 000, if the input was high. The state of bit 7 can then be easily tested by 'jump if positive'; 0000 0000 causes a jump, 1000 0000 does not. With the 6502 the procedure is different in detail. The 'BIT' instruction is used, followed by the address of the line to be read. If the input was low, the N flag in the microprocessor is then made low (0); if the input was high, the N flag is made high (1). The state of the N flag is then tested using either 'branch if plus' (BPL) or 'branch if minus' (BMI), whichever is more convenient. Programs D and E illustrate the use of these routines.

Although it is not used in the programs given here, it is also possible to read inputs in parallel. The procedure is the same as for setting outputs in parallel, as described last month, using the Port A (XX20) or Port B (XX21) registers.

CUTS IN COPPER STRIPS AT D19, E19, F19, G19, H19 & J19 (NOT AT I19)

ALSO AT I12

SOLDER BLOBS JOIN STRIPS AT C21 TO D21
D16 TO E16
G16 TO H16
E21 TO F21
H21 TO I21

Fig.3. Veroboard track connections and breaks. See Fig.2 for the layout pattern.

Use a 'load' instruction to transfer the data to accumulator. Particular combinations of high and low inputs may then be looked for by suitable logical operations.

Other Kinds Of Input

As far as the MPU is concerned a high input is a high input and nothing more. Only the operator knows what device is connected to the input and what a high or low input value means in terms of the world outside. The MPU must be programmed to make the appropriate response. It follows that these programs can also be used to process inputs from other sources. The pressing of a button at the front-door or the breaking of a contact on a windowframe can equally well be made to put these programs into action. In later episodes we shall find several more ways to use these basic programs. We have not finished with the light-level interface yet, either. It can do more than detect intruders or the cat; it can be used to count objects or people as they pass by, it can be used in a lap-timer. Programs for these applications will appear in the next part. But, before we get to these, here is a way to extend the ability of the microprocessor on its output side. Although the LEDs are ideal as indicators of the state of outputs and are very useful when we want to test or develop programs that produce output changes, ultimately we need to be able to control devices that use far greater power. Here are some ways of doing this.

Driving Relays

A relay is simple to instal and to oeprate, though it is a relatively expensive item to use in any quantity. Its great advantage is that it can handle large currents and is capable of switching alternating current, whereas transistor switching circuits can usually handle only direct current. If mains power is to be switched – as in frequently the case in applications in the home, then a relay is usually the best method of control.

The simplest type of relay to work with is the kind specially made for operate from TTL outputs. Fig.4 shows how a single TTL IC can control up to 4 separate relays. The NAND gates are being used as inverters, so the microprocessor outputs need to be low to energise the relay coil. Relays of this type are available with either a simple on-off switch, or a single change-over switch, both forms with either single or double pole. The mechanism is sealed in a small case the same size and shape as a TTL IC and provided with 14 terminal pins, dual-in-line. Thus it fits in neatly among the ICs on the circuit-board. Such relays can handle currents up to about 0.5 A at voltages up to 100 V DC they are very suitable for projects requiring the control of low-voltage lighting (12 V or 24 V supply) or for other low-voltage applications such as operating the points of a model railway system, and controlling low-voltage motors. With a few light-level interfaces to detect the position of the train and a few relays to

control the points and locomotive, you have the beginnings of an automated model railway. There is also a series of reed relays slightly larger than the DIL form, and considerably cheaper, that fill the same function; the 6–9 V range of these can be operated by TTL.

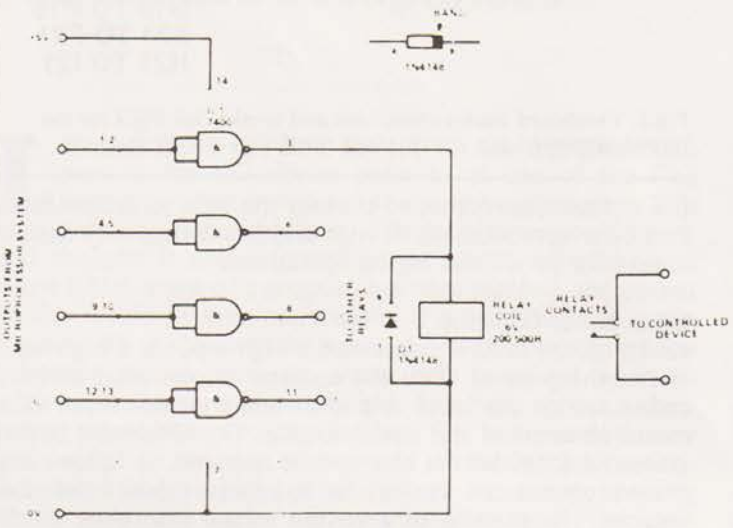

Fig.4 diagram for the relay interface unit. It is capable of driving any TTL relay for low voltage control.

Figure 4 shows the relays being controlled by NAND gate outputs but they can, of course, be controlled by *any* TTL output. If you need to operate six relays, it would be more economic to use the 7404 hex inverter.

For certain applications it may be more convenient to use the 74118 hex bistable IC, this can drive six relays; each is energised when the bistable to which it is connected receives a low pulse to its input. It stays energised until a low impulse comes to the reset input of the IC (from a seventh output line) whereupon all bistables are reset and all relays de-energised. Apart from these variations we need not consider any further use of TTL logic, for most of the logical operations will be done by the microprocessor, not by external circuits.

To switch mains current or large DC currents we need a more substantial relay. The current required for energising the coil cannot normally be safely derived from a TTL output. Instead we use a transistor to switch the relay on and off (Fig.5). When the microprocessor output goes high, the transistor is switched on; current flows through it, energising the relay coil. The source of current can be the +5 V power rail of the microprocessor system, especially if only one or two relays are to be driven. However, this could present an excessive load on the voltage regulator of the system and there is certainly no need for a regulated supply for the relay coil. Power may be derived directly from the positive terminal of the power-pack, provided that this is rated sufficiently high to supply both the microprocessor boards and the relays. The fact that the unregulated power pack supply is usually a few volts higher than +5 V makes no difference. Alternatively, an entirely separate power source may be used – another power-pack, or a battery – but if so, the 0 V line of this source must be connected to the 0 V line of the microprocessor system. It is also permissible to use a source of higher voltage, should the relay coil require it, but do not exceed the maximum permissible collector-emitter voltage (V_{CEO}) of the transistor. For the ZTX300, V_{CEO} = 25 V.

Both Fig.4 and Fig.5 show a diode connected across

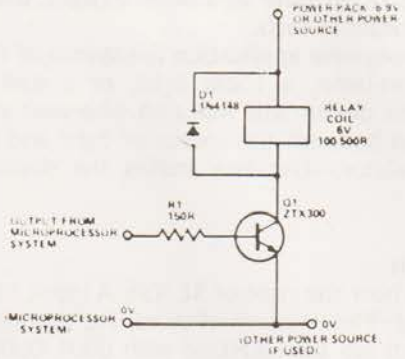

Fig.5. Single relay control with a transistor driver. This avoids having to use the micro supply to power the relay.

the terminals of the relay. A relay is an inductive load, so its coil generates a large *reverse* current when the supply to it is turned off. This large current can damage the switching transistor and possibly other parts of the circuit. The diode avoids this hazard by discharging any currents as they occur. Some types of DIL relay have the diode already built-in, but it is as well to check that this is so before omitting the diode from your circuit.

The current that is switched by the relay normally comes from an entirely separate source – most often the mains. There should be no electrical connection between the contacts of the relay and the relay coil. When wiring connections to the contacts remember that mains currents can shock or even kill. Unless you are absolutely certain of what you are doing and how to wire mains supplies safely, call in experienced advice.

Transistor Switching

The relay of Fig.5 could be replaced by any other device that requires a relatively small current (up to 60 mA DC). This can be switched directly by the transistor, without the need for a relay and with consequent saving in expense, space and circuit complexity. Filament lamps rated at 60 mA can be switched in this way. As before, the power source can be independent, so lamps rated at 12 V or 24 V can be used. A special type of buzzer is available (Maplin Electronic Supplies) that requires only 15 mA and operates from 6 V; this emits a very loud noise and is highly suitable for alarm systems or as an indicator. Being a solid-state device, it is non-inductive so, when using this (or filament lamps), the discharging diode, D1, is not required.

With relays and transistors as switches there is really no limit to the number and kinds of electrical device that your microprocessor can control.

In the next gripping episode we will be asking "Do you ever talk to your micro"? Probably you do at times, but does it hear you? After attaching our next interface your micro will be able to hear as well as see. We will also give some more applications for the light-level interface.

Program A: To set Flag 3 when a light beam is broken: use output 2 from light-level interface. For SC/MP (relocatable)

```
0F20  06        A :CSA
0F21  D4  10      ANI '10'; picking out the Sense A bit
```

```
0F23  98  FB          JZ to A if Sense A is low; continue if
                      high
0F25  C4  04      B :LDI '04' (=0000 0100)
0F27  07              CAS sets Flag 3 bit
0F28  3F              XPPC P3 return to monitor
```

Program B: To set Flag 3 for as long as the light-beam is broken. For SC/MP (relocatable)

```
0F20–0F27, as in Program A
0F28  8F  FF          DLY to give ¼ second flash
0F2A  C4  00          LDI '00'
0F2C  07              CAS clear flag bits
0F2D  90  F1          JMP to A repeat sequence
```

Program C: To flash Flag 3 when a light beam is broken. For SC/MP (relocatable)

```
0F20–0F2C, as in Program B
0F2D  8F  FF          DLY flag cleared for ¼ second
0F2F  90  F4          JMP to B to continue flashing
```

Program D: To set output B3 when a light-beam is broken: use output 2 from light-level interface. For 6502 (Acorn) (relocatable)

```
0200  A9  FE          LDA # 'FE' (= 1111 1110)
0202  8D  23  09      STA at 0DB B0 as input, rest as
                      outputs
0205  A9  00          LDA # '00'
0207  8D  21  09      STA at Port B register, clear all
                      outputs
020A  2C  08  09  A   :BIT read state of B0 input; if low
                      N=0; if high (light-beam broken),N=1
020D  10  FB          BPL if N = 0 to A to wait
020F  8D  1A  09      STA # beam broken, N=1 so set
                      output B3
0212  4C  04  FF      JMP to monitor
```

Program E: To set output B3 for as long as the light-beam is broken. For 6502 (relocatable)

```
0200–0211, as in Program D
0212  2C  08  09  B   :BIT read state of B0 input;
0215  30  FB          BMI if N = 1 to B to wait
0217  8D  0A  09      STA # beam restored, N=0, so clear
                      output B3
021A  4C  04  FF      JMP to monitor
```

Program F: To flash B3 when a light beam is broken. For 6502 (relocatable)

```
0200–0211, as in Program D
0212  A0  30          LDY # '30'; value determines
                      flashing rate
0214  20  CD  FE  B   :JSR to WAIT
0217  88              DEY counting loops
0218  10  FA          BPL to B, if Y still positive
021A  8D  0A  09      STA clear B3 output
021D  A0  30          LDY # '30' restore counter Y
021F  20  CD  FE  C   :JSR to WAIT
0222  88              DEY counting loops
0223  10  FA          BPL to C, if Y still positive
0225  4C  0F  02      JMP to 020F, to repeat flash
```

Program G: To display a message when a light-beam is broken. For SC/MP (relocatable)

```
0F1F                  = counter, k
0F20  06          A   :CSA
0F21  D4  10          ANI '10' picking out the Sense A bit
0F23  98  FB          JZ to A if Sense A is low; continue if
                      high
0F25  C4  0D      B   :LDI '0D' pointing P1 to display
0F27  35              XPAH P1     (0D00)
0F28  31              XPAL P1
0F2B  C4  0F          LDI '0F' pointing P2 to message
0F2D  36              XPAH P2     (0F40)
0F2E  C4  40          LDI '40'
0F30  32              XPAL P2
0F31  C4  08          LDI '08'
0F33  C8  EB      C   :ST in counter, k
0F35  C6  01          LD@P2+1 get first character of
                      message
0F37  CD  01          ST@P1+1 store it in first display
                      position
0F39  B8  E5          DLD k becomes k–1
0F3B  9C  F6          JNZ to C to get and store next
                      character
0F3D  90  E6          JMP to B to repeat display sequence

Message table   0F40 to 0F47

0F40  00  50  7B  6F  54  5F  5E  00
```

PARTS LIST

Resistors All 0.125 W, carbon, 5% or 10%.

R1	see text
R2	270k

Semiconductors

TR1	BPX25, phototransistor
IC1	7413 duel 4-input Schmitt trigger NAND

Simon Ainsworth

As an exercise a couple of weeks ago I set myself the problem of writing an unusual short non-game program which would be of use to a large number of people. The result of my labours is enclosed together with an example of a running.

Anyone who has ever learnt a foreign language will know how tedious vocabulary learning can become. Furthermore the system of working through a list of vocab has the disadvantage of also teaching you the order in which the words occur, so although you might be able to get full marks testing yourself on each word in turn you might not be able to remember the foreign equivalent of a word chosen randomly from the list.

Software Details

My program contains three looped routines (which may be exitted by entering "B" for break). The first routine allows the user to teach the computer new vocabulary, the second tests the user on each word in turn (this ensures that every word is tested before going on to the third routine), and the third chooses words at random and should be used to polish off previously learnt vocab thus eliminating the order problem described above.

This method of learning, apart from being more thorough than the conventional method, is also considerably faster and less laborious. Interested readers might also like to extend the program's facilities for example by adding some sort of classification system so that the user may choose to be tested on all vocab related to a particular subject eg. shops, animals, professions etc.

Program Example

An example of the program being run (in this case the data file is initially empty although this need not be so).

```
RUN
WHAT LANGUAGE ARE YOU LEARNING? GERMAN
LEARN, SEQUENTIAL TEST, RANDOM TEST OR END
(L,S,R OR E)? L
ENGLISH WORD/PHRASE? POTATO
GERMAN EQUIVALENT? DIE KARTOFFEL
ENGLISH WORD/PHRASE? ENTRANCE
GERMAN EQUIVALENT? DER EINGANG
ENGLISH WORD/PHRASE? LIMITATION
GERMAN EQUIVALENT? DIE BESCHRA"NKUNG
ENGLISH WORD/PHRASE? B
LEARN, SEQUENTIAL TEST, RANDOM TEST OR END
(L,S,R OR E)? S
WHAT IS THE GERMAN FOR POTATO? DIE
KARTOFFEL
CORRECT!
WHAT IS THE GERMAN FOR ENTRANCE? DER
EINGANG
CORRECT!
WHAT IS THE GERMAN FOR LIMITATION? B
LEARN, SEQUENTIAL TEST, RANDOM TEST OR END
(L,S,R OR E)? R
WHAT IS THE GERMAN FOR ENTRANCE? DIE
EINGANG
NO! – THE GERMAN FOR ENTRANCE IS DER
EINGANG
WHAT IS THE GERMAN FOR POTATO? B
LEARN, SEQUENTIAL TEST, RANDOM TEST OR END
(L,S,R OR E)? E
READY
```

Note: The definite article should be included with foreign nouns, and accents and umlauts etc. should be written after the corresponding letter eg. the French word for pupil, eleve, should be written thus: E/LE\VE.

LINGO.BAS

```
 10  !! PROGRAMME TO AID VOCABULARY
     LEARNING !!
 20  !! CODED IN SYSTIME RSTS–11 'BASIC–PLUS' !!
 30  !! BY SIMON AINSWORTH, MGS INSTALLATION !!
 40  !!                INITIALISATION                !!
 50  ON ERROR GOTO 320
 60  PRINT:INPUT"WHAT LANGUAGE ARE YOU
     LEARNING";L$
 70  PRINT:INPUT"LEARN, SEQUENTIAL TEST,
     RANDOM TEST OR END (L,S,R OR E)"; A$: GOTO
     300
 80  !!                LEARN ROUTINE                !!
 90  OPEN "LINGO.DAT" AS FILE 1
100  INPUT LINE #1,A$: GOTO 100
110  PRINT:INPUT"ENGLISH WORD/PHRASE"; E$:
     A$ = E$ : GOSUB 290
120  PRINT L$;"EQUIVALENT"; : INPUT F$ : A$ = F$:
     GOSUB 290
130  PRINT #1,E$ : PRINT #1,F$ : GOTO 110
140  !!          SEQUENTIAL TEST ROUTINE          !!
150  OPEN "LINGO.DAT" AS FILE 1
160  INPUT LINE #1,E$ : INPUT LINE #1,F$
170  PRINT: PRINT "WHAT IS THE";L$;"FOR";E$; ;
     INPUT A$ : GOSUB 290
180  IF A$ = F$ THEN PRINT "CORRECT!" : GOTO 160
190  PRINT "NO! – THE";L$;"FOR";E$;"IS";F$ : GOTO
     160
200  !!          RANDOM TEST ROUTINE          !!
210  OPEN "LINGO.DAT" AS FILE 1 : N = 0
220  INPUT LINE #1,A$ : N = N+1 : GOTO 220
230  OPEN "LINGO.DAT" AS FILE 1 : RANDOMIZE : R
     = INT (RND*N/2)*2+1
240  INPUT LINE #1,E$ FOR I = 1 TO R : INPUT LINE
     #1,F$
250  PRINT:PRINT "WHAT IS THE";L$;"FOR";E$; :
     INPUT A$ : CLOSE 1 : GOSUB 290
260  IF A$ = F$ THEN PRINT "CORRECT!" : GOTO 230
270  PRINT "NO! – THE";L$;"FOR";E$;"IS";F$ : GOTO
     230
280  !!          CROSSROADS ROUTINE          !!
290  IF INSTR (I,"BELRS",A$) = 0 THEN RETURN ELSE
     CLOSE 1
300  ON INSTR (I,"BELRS",A$) GOTO 70,350,90,210,
     150
310  !!                ERROR ROUTINE                !!
320  IF ERL <> 100 OR ERR <> 11 THEN CLOSE 1
330  IF ERR <> 11 GOTO 350
340  IF ERL = 100 THEN RESUME 110 ELSE IF ERL =
     160 THEN RESUME 70 ELSE RESUME 230
350  IF ERR THEN PRINT : PRINT "ERROR";ERR;"AT
     LINE";ERL : END
```

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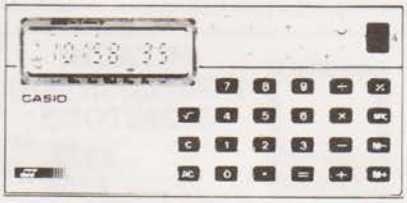

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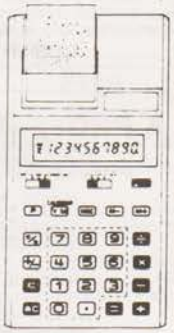

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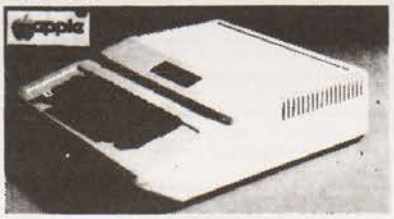

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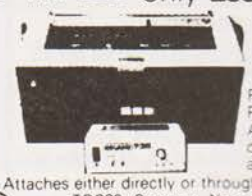

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