June 1982

The independent magazine for the independent user

sinclair user

Only 60p

JOIN THE SINCLAIR USER CLUB

ZX SPECTRUM: CLIVE DOES IT AGAIN

We interview Nigel Searle, head of Sinclair's computer division

A mother's view of the computer generation

Meet the winner of our first competition

Eight pages of programs

Plus:
helpline, mind games, new products, book reviews

WIN A SPECTRUM

Early promise is shown by colourful Spectrum

Robin Bradbeer looks at Sinclair Research's new ZX Spectrum and finds it 'incredible' value at £125

THE SPECTRUM is a colour and sound computer for the incredibly low price of £125. At that price it undercuts the BBC Microcomputer Model A, its direct competitor, by around £175. In designing the ZX-82 it is clear that the rejection of Sinclair's offer to build the BBC Micro was foremost in the company's mind. The specification is very similar and will certainly affect sales of the Acorn-based machine. It is as if Clive Sinclair has turned to the powers that be in the Government and BBC and said "I told you so".

The Spectrum is a small computer, measuring 233 × 144 × 30mm, or slightly wider but not so deep as the ZX-81. The basic model has 16KB of RAM and 16KB of ROM. That compares to most other common computers for ROM but it is more RAM than most models in the less-than £300 price range.

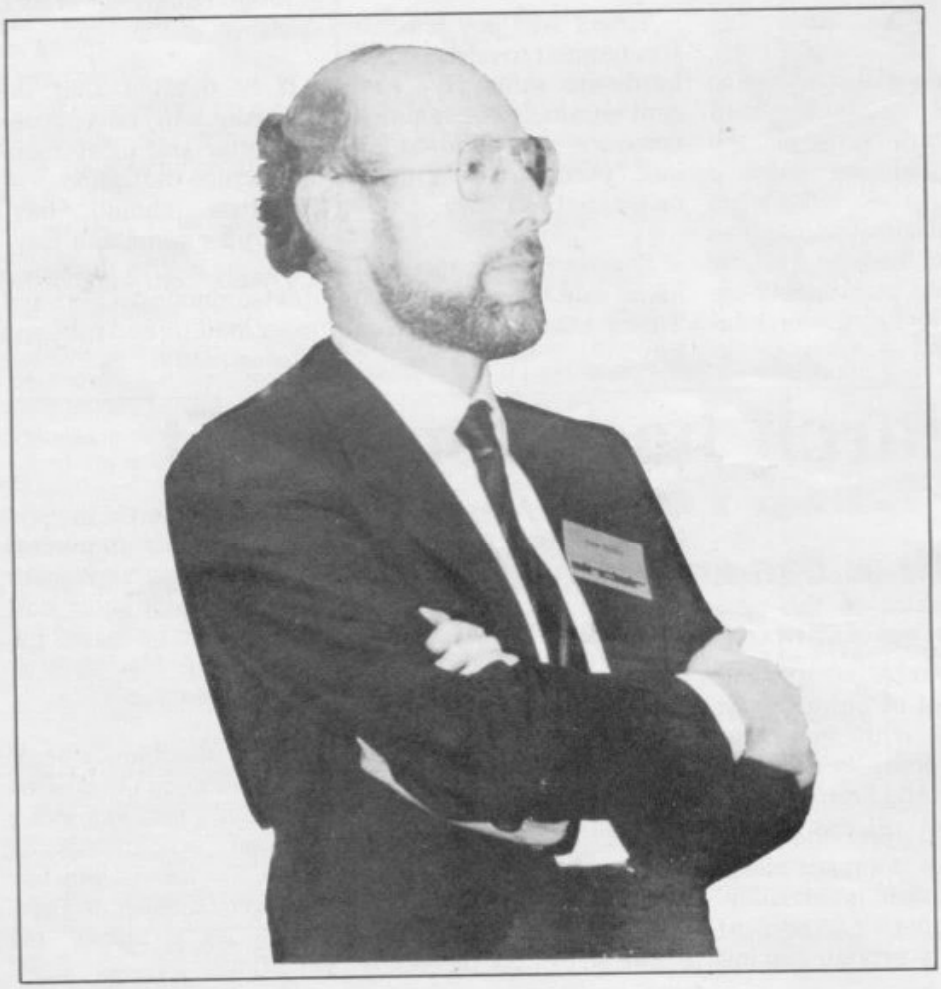
RAM indicates the amount of memory available to the user for working data and programs and ROM is an indication of the power of the computer to run that program and manipulate the data.

Another 32KB of memory is available at around £50 and that plugs into some sockets already built into the main board. The 48KB RAM model, therefore, is potentially as powerful as the very common Apple II computer costing around three times the price.

The main difference between the ZX-82 and the ZX-81 is immediately obvious. The keyboard has 40 keys, the same as the ZX-81. Some of the keys, notably the enter key, are slightly larger than the others. Whereas the ZX-81 had a touch-sensitive keyboard, the ZX-82 has a keyboard with keys which are about half the size of typewriter keys. They move downwards firmly and feel like the keys on desk-top calculators.

The other noticeable feature is the number of functions on the keyboard. More than 250 functions are available and some of them require three shifting operations. The colour coding of the keys and their functions makes life very easy, however, and with the single-key access to all functions, which is similar to the ZX-81, you soon become familiar with the conventions and could easily prefer them to the more normal way of doing things.

For example, to obtain the square brackets symbol involves going into extended mode, accessed by pressing the symbols shift and capitals shift keys at the same time. Then you have to press either shift and the Y key. Although that may seem rather long-winded it is still shorter than typing VERIFY, which is achieved in a similar way to the square brackets but is on the 'R' key as a single function.



Colour coding is effective in this case and the designers are to be complimented on the ergonomic strength, as well as for the design of the whole package, which feels very comfortable to hold and looks very presentable on a desk.

The Spectrum plugs into a normal UHF TV tuned to channel 36 and all characters are shown lower-case unless specified by using the capitals shift. There is a capitals lock, which is very useful. The Basic is based on that of the ZX-81 and some of the features lacking on the original model have been included in the latest one.

The screen can display 24 lines of 32 characters, although the individual pixels which make up each character—64 in all—can be accessed and changed at will. That means that 256 × 192 pixels is available for graphics.

The screen format is very similar to the Commodore. Vic, with a border area and the active screen within the border. At switch-on, the system automatically enters a mode where border and screen area, or paper as it is called, are white and the letters, or ink colour, black. That overcomes the strange effect noticeable on some colour computers where the border area is different from the working area, which makes the screen look smaller than it is.

The colours of the border, paper and ink can be changed easily with commands of the same name. Eight colours are available, although judicious use of the graphics characters available make intermediate colours, like orange, possible. It is also possible to have 21 user-defined graphics characters, which will allow Greek or other alphabets to be used.

Unlike some computers built in the States, the Spectrum also has a £ sign on the keyboard; everything can be printed on the ZX printer, which can be used for the ZX-82 as well as the ZX-81, although the ZX-81 expansion memory pack cannot be used with the Spectrum.

Many commonly-used routines in the graphics are available automatically. For example, a circle can be drawn with the 'circle' command by specifying the centre and diameter. Lines can be drawn with the 'draw' command by specifying start and end locations.

The colour control commands are very simple to use. Brightness can be at two levels, and the character can be steady or flashing. The attributes of the character are stored as a single byte and can be accessed and changed from the Basic.

In addition to the ink and paper commands, the Basic has brightness and flashing commands. Other useful graphics functions include an over command which allows characters to be super-imposed at any point. The six colour control commands can be used over the whole active screen area or locally within each individual 8 × 8 pixel group which makes up each character.

Like the ZX-81 the plot command accesses one pixel at a time and the attributes of each block can be used to control the characteristics of that pixel. Colour control codes, which can be accessed directly from the keyboard, can be inserted into text or program listings and, when displayed, will over-ride the globally-set colours until another control code is encountered.

All control commands can also be used within strings and it is entertaining to define a string which has different-coloured characters and background colours in it. A simple print command using that string causes it to be printed to screen just as stored.

Another powerful use of colour in listing is that certain sections of the listing can be picked out in different colour—both the colour of the character and its background. It is also possible to have flashing REM statements. Any colour used in the listing is not used when running the program.

The eight colours are given numbers from 0 to 7 and they are shown clearly above the keyboard numbers. The order gives a graded grey scale on a monochrome TV display. They are black, blue, red, magenta, green, cyan, yellow and white. All eight colours may be on the screen at the same time, with some areas

(continued on page 16)

'The 48KB RAM is potentially as powerful as the Apple II costing around three times the price'.

(continued from page 15)

flashing, some steady, some normal brightness and some extra bright.

Editing is the same as for the ZX-81 but the addition of auto-repeat on every key makes editing easy, especially when moving the cursor around a long line.

Some additions to the Basic include the means to enter a binary number directly. That is the method of generating the user-defined characters, of which there can be 21 directly-attributable to some of the keys on the keyboard. The 8 × 8 matrix is made up by defining the character as a series of eight bytes, each byte being one line of the character. A 1 indicates a pixel and a 0 the absence of one. Other new functions include READ, DATA and RESTORE, something which was sorely missing on the ZX-81. FN and DEF FN are also there.

One of the best new additions to the specification is the ability to type in lower-case. That certainly makes reading and writing programs easier, especially as the keywords are still capitals. So strings, variables and arrays can be specified in a way which is simpler to use.

Unlike the ZX-81, the Spectrum uses true ASCII codes for its alpha-numeric characters and control codes. That means that ZX-81 cassettes cannot be read into the Spectrum. Other than the absence of SLOW, FAST and SCROLL, however, the Basic is identical. There is no need for FAST or SLOW, as the memory-mapped screen overcomes the need for screen writing during interlacing, as on the ZX-81. The ZX-82 has the speed of the ZX-81 in fast mode with the screen characteristics of the ZX-81 in the slow mode.

One of the problems with both the ZX-81 and its predecessor, the ZX-80, was the rather idiosyncratic working of the cassette storage. The Spectrum incorporates a new cassette interface which is incompatible with the ZX-81. A tone leader is recorded before the information to overcome the automatic record level fluctations on some recorders.

An electronic circuit, called a Schmitt trigger, is used to remove noise on playback. All saved information is started with a header as to its type, title, length and address information. A number of types of information can be stored on cassette—programs, blocks of memory and arrays.

The MERGE function allows programs to be merged and the VERIFY function allows stored data to be checked before being erased from the computer memory, so programs and arrays may be merged from tape to combine them with the existing contents of memory; where two-line numbers or variable names coincide, the old one is erased.

Programs can also be saved with a line number to allow execution to start anywhere in the program on successful loading. By storing the screen memory, it is possible to load a screen image without having to run any program required to generate that image.

The ZX-82 has an expansion port similar to the ZX-81, with the addition of the colour video information. Thus a colour monitor could be attached to give a high-quality display. Full data, address and control buses for the Z-80 processor are available and the ZX printer can be plugged-in directly.

The LPRINT, LLIST and COPY commands work with Spectrum Basic, with the additional bonus that any user-defined graphics will also be printed. It is also possible to run a number of other peripherals at which Sinclair has only hinted. There will be an RS232C interface, so that standard printers can be attached. There will also be a network with an interface which fits on the expansion port, as will the ZX-Microdrive, to be launched later this year. It is possible to access all I/O ports by using the IN and OUT commands in the Basic.

The Spectrum has a very basic sound capability. The internal speaker emits a 'raspberry'-like sound, set normally at a frequency of middle C. The pitch and duration of the note can be defined in the Basic with the BEEP command. The centre frequency being middle C, any other note can be defined by the number of semitones above or below that frequency. It is also possible to have fractional intervals so that unusual scales can be generated.

In summary, the ZX Spectrum is a very fine computer and at the price will give Commodore, Acorn/BBC and Atari a run for their money.

Crowds trying to see the ZX Spectrum at the Earls Court Computer Fair

'The ZX Spectrum is a very fine computer and will give Commodore, Acorn/BBC and Atari a run for their money'.

Elspeth Joiner talks to Nigel Searle, new chief of Sinclair's Computer Division

Plotting a course for growth

THE launch of the Spectrum is only a part of the development plans of the Sinclair Research computer division in the coming year. The company also intends to produce another small computer, market a full range of peripherals and software for all its computers, and expand overseas and into the educational market.

The man behind the ambitious expansion plans is the newly-appointed head of the division, Nigel Searle.

"I expect we will launch at least one new computer which will not replace the ZX-81, but which will sell alongside the ZX-81 and be the beginning of a range of computers", he said.

"By the end of the year they will be fully-supported in terms of peripherals and software. We have already developed a mass storage device which is of our own design and that will be announced later this year".

He added that in future Sinclair intends to launch new computers with a full range of software.

Of the educational market, Searle said: "Many schools have a ZX-81, but the price of them is such that many schools ought to have 20 or 30 of them. We hope to penetrate that market in the U.K. and elsewhere".

This ties with his plans for overseas growth. The company is in the middle of searching for foreign distributors.

"We expect our overseas sales to increase substantially", he said.

Searle became head of the computer division four months ago and has a long association with Clive Sinclair. He first joined him in the Sinclair Radionics company 10 years ago designing pocket calculators. He then moved to the U.S. first in California and later in New York, where he was responsible for promoting the company's calculators and watches.

He stayed with the company until 1977 when he left. "The calculator business was not doing too well and also it was not really the same company once the National Enterprise Board was involved", he said.

Two years later Clive Sinclair formed Sinclair Research, launched the ZX-80 and Searle rejoined him. He ran the U.S. office in Boston, concentrating on selling the ZX-80 and 81 until taking-up his new job.

Software is an area in which Searle is particularly interested. The company has begun a software development project which should build the library to 200 programs by the end of the year.

"They will be available only through W H Smith, 26 to start with, which is just the tip of the iceberg, covering games, education and some business. It is an area we have neglected in the past but we have spent time getting together a wide range of software for the ZX-81".

Searle has been involved closely with the launch of the Spectrum and he has decided to continue Sinclair's unusual marketing strategy of concentrating on mail order.

"With minor variations we are launching our new products the same way we always have done", he said, but added, that "there are no plans at present for putting the new machine into W H Smith, which is Sinclair's only retailer".

He said the reason was that "not many others are selling so many computers as we are. We have sold

(continued on page 44)

(continued from page 43)

far more computers by mail order than anyone who has sold through stores".

He added that the original idea behind the mail order decision was that when Sinclair first went into the computer market there was no obvious retail outlet for a personal computer.

"It does not occur to me, or anybody else, that Boots, Currys, Rumbelows, would sell a computer.

"It also makes good sense financially to sell through mail order. We do not have to give a discount to retailers which you normally have to do".

The promotion of a new product through retail distribution can cost so much that the price of the product has to be raised by 50 percent.

Heavy advertising is still essential and Searle again adopts an unusual policy by not having a pre-determined budget.

"We are willing to spend as much on advertising as will produce a profitable number of sales", he explained. Last year the cost was slightly more than £5 and in 1982 it looks as if it will be more than £10 million.

Where that is spent depends on the product with advertising in the technical press computer journals, particularly the magazines, and the Sunday magazines.

"So far we have had products which have been of interest to both the specialist computer market and the general enthusiast market but we might well have products in the future which would be of interest only to your serious computer user".

For the Spectrum, Searle is concerned not only with selling the machine but also with persuading people that is it better than rival products. "We would not introduce a computer unless it was significantly different from our existing one. It will appeal to a much wider market and we will be trying to persuade people to buy it in preference to other products," he said.

His return to Britain has made life much more hectic than it was when he was in Boston selling the two ZX computers.

"So far working here has been a bit like jumping on a train which is passing at about 60mph. It seems as though there are many things to be done".

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

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

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

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

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

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

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

New BASIC manual

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

Kit: £49.95

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

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

New, improved specification

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

Built: £69.95

Kit or built – it's up to you!
You'll be surprised how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 700 mA at 9 V DC nominal unregulated (supplied with built version).

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

uter-

Available now- the ZX Printer for only £59.95

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

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

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

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

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

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

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

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

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

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

How to order your ZX81

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

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

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

To: Sinclair Research, FREEPOST, Camberley, Surrey, GU15 3BR. **Order**

Qty	Item	Code	Item price £	Total £
	Sinclair ZX81 Personal Computer kit(s). Price includes ZX81 BASIC manual, excludes mains adaptor.	12	49.95	
	Ready-assembled Sinclair ZX81 Personal Computer(s). Price includes ZX81 BASIC manual and mains adaptor.	11	69.95	
	Mains Adaptor(s) (700 mA at 9V DC nominal unregulated).	10	8.95	
	16K-BYTE RAM pack.	18	29.95	
	Sinclair ZX Printer.	27	59.95	
	8K BASIC ROM to fit ZX80.	17	19.95	
	Post and Packing.			2.95

☐ Please tick if you require a VAT receipt TOTAL £

*I enclose a cheque/postal order payable to Sinclair Research Ltd, for £

*Please charge to my Access/Barclaycard/Trustcard account no.

*Please delete/complete as applicable.

Please print.

Name: Mr/Mrs/Miss

Address:

FREEPOST – no stamp needed. SUS06

sinclair

ZX81

6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Tel: (0276) 66104 & 21282.

Machine code complex

In the second of his three articles on machine code, Mike Biddell works out a more complex routine which could have a number of applications.

IN PART one, we developed some of the basic machine code concepts and produced a machine code loader which poked the code into a REM statement at line one in the Basic programme.

A very simple four-byte program was stored in the REM statement and called with USR.

The machine code loader will now be used to develop a more complex machine code routine, which will be a useful addition to your subroutine library.

At this stage, we will not be too ambitious and it is probably realistic to choose the example we mentioned in part one, scroll down. That is to say, we will attempt to write a machine code routine which, when called once, moves every line on the screen down one, leaving the top line blank and making the bottom line disappear. This could have any number of applications either in games or in a rudimentary work processor.

You will need the 16K RAM pack added at this stage. When the screen is full, which is the case with most games, the 1K RAM is generally insufficient and the addition of the 16K RAM pack automatically reserves space for a full display. With a collapsed display file, the coding of our scroll down program become difficult to understand.

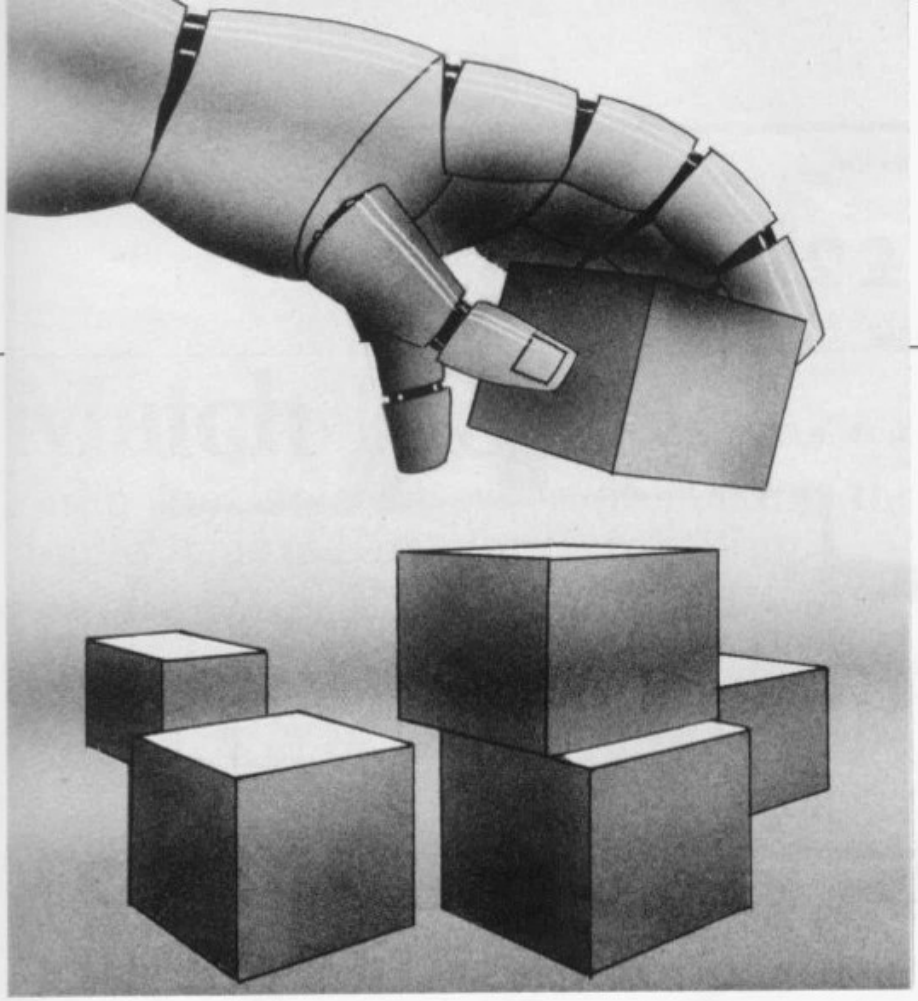
The 1K machine operates with no memory reserved for display and builds-up the display file as you print characters on the screen.

To start writing a machine code routine we first need some knowledge of the registers available in the Z-80 chip. A register is a place/device which can hold one instruction or piece of data (byte), where we can work on it. It is stored in the register as a series of eight zeros or ones (bits) in any combination, for example, 00001100 is the bit pattern for increment (add one to) the 'C' register. For this reason, the Z-80 chip is known as an eight-bit processor.

The registers we will mainly be using are the accumulator (A), H, L, D, E, B, C, and the flag (F) register. The accumulator and flag registers are special-purpose registers; the other six are very similar, can be

Figure 1: MACHINE CODE SCROLL DOWN FOR 16K ZX-81

	HEX	DECIMAL		
STEP	CODE	CODE	NEMONIC	COMMENT
1	2A 0C 40	42 12 64	LD HL (40 0C)	Load the display file. Start address into HL.
2	11 72 02	17 114 2	LD DE, 626 DEC	Size of screen to be scrolled.
3	19	25	ADD HL, DE	Point HL at last character on screen to be scrolled.
4	E5	229	PUSH HL	Temporarily store this address on the stack.
5	06 21	6 33	LD B, 33 DEC	Load B register with V.D.U. line length.
6	23	35	INC HL	Point HL to one line below by incrementing.
7	10 FD	16 253	DJNZ – 1	HL 33 times.
8	E5	229	PUSH HL	Temporarily store this address on stack.
9	D1	209	POP DE	Put the HL value off the stack into the DE register.
10	E1	225	POP HL	Bring back the original HL value into HL
11	0E 13	14 19	LDC, 19 DEC	No of lines to scroll.
12	06 21	6 33	LD B 33 DEC	Length of line including line end marker.
13	7E	126	LD A, (HL)	Load A, with the character code pointed to by the HL pair.
14	12	18	LD(DE), A	Load the position pointed to by the DE pair with the character code in A.
15	1B	27	DEC DE	Point DE at the next position.
16	2B	43	DEC HL	Point HL at the next character to be copied down.
17	10 FA	16 250	DJNZ – 4	Repeat above four steps thirty three times (one line).
18	0D	13	DEC C	Reduce line count by 1.
19	20 F5	32 245	JRNZ – 7	Jump back to step 12 if line count not zero.
20	C9	201	RET	Return to BASIC programme.



interchanged and used as pairs such as HL, DE, BC.

They can be used to hold addresses pointing to various parts of the computer memory, because you need 16 bits to address any meaningful quantity of memory.

The accumulator works like any one of the six general-purpose registers but can also be used to perform arithmetical and logical jobs, whereas the general-purpose registers cannot.

The flag register generally is used to tell us whether the result of an operation is zero or not. Testing one bit in this register will tell us, for instance, if subtracting one from the C register resulted in zero. This is used frequently and is very useful.

In the ZX-81, the system shifts the area of memory used for the display; but being a very courteous computer it keeps us constantly informed of where it has gone, by putting its new start address (two bytes – sixteen bits) in system variables 16396 and 16397. This is presented as the least significant bit at 16396 (lowest part of the number, i.e. up to 256) and the most significant bit second at 16397 (product of 256).

The number stored at 16397 must therefore be multiplied by 256 to give the higher order part of the address, so to locate the D file address we must evaluate:

PEEK (16396) + 256 * PEEK (16397).

At any time, we can locate the start address of the D file by using no line number and PRINT followed by the foregoing expression.

We must now think how we will achieve scroll down in general terms, forgetting about coding for the minute. We shall proceed now by writing in words how we expect the programme to flow, although we may have to alter our concept later.

Begin by finding the address of the start of the display file and store it in a register pair and then find the address of the end of the display file, or as much of the display file as we wish to scroll and also store it in a register pair, HL registers say. Load the DE register pair with the address directly below HL on the screen; this will involve adding decimal 33 to the HL address, since there are 33 addresses per screen line.

Next shift the character at the position pointed to by HL to the position pointed to by DE. (Repeat for one whole screen line). This will print the whole of the line scanned by HL to the positions below scanned by DE. Shift the addresses of HL and DE up the screen by one line and repeat.

Then repeat until the whole screen has been processed in this way. Each line on the screen has now been copied to the line below so return to basic (RET).

The completed routine is shown in Figure 1. It was produced by using the rough list flowchart, presented above and the Mostek Z-80 programming manual. It uses the simple programming elements we described in the first article.

To understand fully the step from flow chart list to the finished program, you should study Figure 1 and the comments in depth, until you can understand to your satisfaction what is happening.

We now need to enter the code into your computer to test that it works correctly. Ensure you have your 16K RAM attached or it will not work.

Enter the machine code loader we developed last time, RUN it and type in the decimal code, entering NEWLINE after each number.

After entering the last code, enter MM NEWLINE to break out of the program. Now delete all lines except one and three and add lines 10, 20, 30, and 40 as shown in Figure 2, the scroll down test program.

When you now RUN the program, "HELLO" should be printed in the centre of the screen and, after a short delay, it should move down one line. It works – congratulations.

Save this program on tape, since in the third article we will explain how the routine might be called from a Basic program to produce an interesting game.

Figure 2: SCROLL DOWN TEST PROGRAM

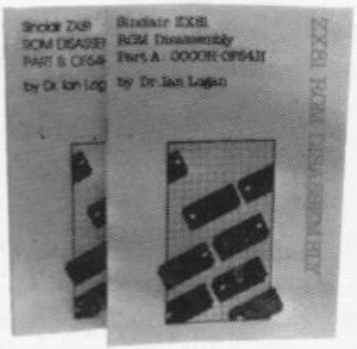
```
    1 REM E£RND)?*; FAST ▗57( CLE
AR FAST SGN LPRINT : ◢5$4 PRINT
TAN MMMMMMMMMMMMMMMMMMMMMMMMMMM
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
MM
    3 LET T=16514
   10 PRINT AT 11,12;"HELLO"
   20 FOR I=0 TO 50
   30 NEXT I
   40 LET A=USR (T)
```

"Best explanation I've seen . . . this is a must" *

"Best independent software package for the ZX81" ★

MACHINE LANGUAGE MADE SIMPLE FOR YOUR SINCLAIR
Syntax * Magazine said: "It's the best explanation of Machine Language for Machine Language beginners I've seen. Its friendly style is painless reading and simple analogies help make this language clear. This introduction is a must."
Available as a quality paperback, 160 pages, £9.75 including post, pack and V.A.T.

UNDERSTANDING YOUR ZX81 ROM by Ian Logan
Dr. Ian Logan was the 1981 winner of the Rosetta Stone Award★, given to the best independent product, software package or application for the Sinclair ZX80 or ZX81, for his perceptive insights into the way the ZX81 ROM operates.
This book explains ZX80 Machine Language in terms of the ZX81 ROM, giving numerous examples of routines from the ROM, and explains the structure and organisation of the ROM, including routines from the ROM you can use yourself.
A special section explains how to use machine code routines in your own BASIC programs.
Available as a quality paperback, 164 pages, £9.75 including post, pack and V.A.T.



ZX81 ROM DISASSEMBLY PARTS A & B
Dr. Logan is also the author of these two titles (see above) which are an invaluable source of information for the serious ZX81 Machine Language programmer.
Part A lists all locations and subroutines in the ROM from 0000H to 0F54H and covers all the operating functions of the ROM except the floating point calculator.
Part B lists all locations from 0F55H to 1DFFH and covers all the routines involved in the 'evaluation of an expression' and a detailed explanation of the 'floating point calculator'.
Part A, 30 pages, £7.80 including post, pack and V.A.T.
Part B, 84 pages, £8.80 including post, pack and V.A.T.

Other titles available:

Not only 30 programs for the Sinclair ZX81: 1K
Not only over 30 programs, from arcade games to the final challenging Draughts playing program, which all fit into the unexpanded 1K Sinclair ZX81 but also notes on how these programs were written and special tips! Great value!
120 pages, £7.75

Complete Sinclair ZX81 Basic Course
The Complete Basic Course is a 240 page in-depth comprehensive text for complete beginners and experienced programmers. Over 100 programs and examples illustrate the use and possibilities of the Sinclair ZX81. This is an invaluable reference guide for all ZX81 owners.
256 pages, £18.30

Special Discount for ordering more than 1 title
If you order more than one title at a time, you get a discount of 80p per additional title:
If you order 2 books, deduct 80p from the total; order 3 books and deduct £1.60; order 4 books and deduct £2.40!!

Orders to Melbourne House Publishers, 131 Trafalgar Road, Greenwich London SE10
Correspondence to: Glebe Cottage, Station Road, Cheddington, Leighton Buzzard, BEDS LU7 7NA

Name .....

Address .....

..... Postcode .....

The Complete Sinclair ZX81 BASIC Course	£18.30	☐
Basic Course Programs on Cassette	£3.30	☐
Not Only 30 Programs/Sinclair ZX81 1K	£7.75	☐
Machine Language Programming Made Simple	£9.75	☐
ZX81 ROM Disassembly Part A	£7.80	☐
ZX81 ROM Disassembly Part B	£8.80	☐
Understanding Your ZX81 ROM	£9.75	☐

Remittance enclosed £.....

Less Special Quantity Discount £.....

50

The first personal computer for under $200.

The Sinclair ZX80. A complete computer—only $199.95 *plus $5.00 shipping.*

Now, for just $199.95, you can get a complete, powerful, full-function computer, matching or surpassing other personal computers costing several times more.

It's the Sinclair ZX80, the computer that independent tests prove is faster than all previous personal computers. The computer that "Personal Computer World" gave 5 stars for 'excellent value.'

The ZX80 cuts away computer jargon and mystique. It takes you straight into BASIC, the most common, easy-to-use computer language.

You simply take it out of the box, connect it to your TV, and turn it on. And if you want, you can use an ordinary cassette recorder to store programs. With the manual in your hand, you'll be running programs in an hour. Within a week, you'll be writing complex programs with confidence.

All for under $200.

Sophisticated design makes the ZX80 easy to learn, easy to use.

We've packed the conventional computer onto fewer, more powerful LSI chips—including the Z80A microprocessor, the faster version of the famous Z80. This makes the ZX80 the world's first truly portable computer (6½" x 8½" x 1½" and a mere 12 oz.). The ZX80 also features a touch sensitive, wipe-clean keyboard and a 32-character by 24-line display.

Yet, with all this power, the ZX80 is easy to use, even for beginners.

Your course in computing.

The ZX80 comes complete with its own 128-page guide to computing. The manual is perfect for both novice and expert. For every chapter of theory, there's a chapter of practice. So you learn by doing—not just by reading. It makes learning easy, exciting and enjoyable.

The ZX80's advanced design features.

Sinclair's 4K integer BASIC has performance features you'd expect only on much larger and more expensive computers. These include:

- Unique 'one touch' entry. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry and are stored as a single character to reduce typing and save memory space.
- Automatic error detection. A cursor identifies errors immediately to prevent entering programs with faults.
- Powerful text editing facilities.
- Also programmable in machine code.
- Excellent string handling capability—up to 26 string variables of any length.
- Graphics, with 22 standard symbols.
- Built-in random number generator for games and simulations.

Sinclair's BASIC places no arbitrary restrictions on you—with many other flexible features, such as variable names of any length.

And the computer that can do so much for you now will do even more in the future. Options will include expansion of 1K user memory to 16K, a plug-in 8K floating-point BASIC chip, applications software, and other peripherals.

Order your ZX80 now!

The ZX80 is available only by mail from Sinclair, a leading manufacturer of consumer electronics worldwide. We've already sold tens of thousands of units in Europe, so demand will be great.

To order by mail, use the coupon below. But for fastest delivery, order by phone and charge to your Master Charge or VISA. The ZX80 is backed by a 30-day money-back guarantee, a 90-day limited warranty with a national service-by-mail facility, and extended service contracts are available for a minimal charge.

Price includes TV and cassette connectors, AC adaptor, and 128-page manual.

All you need to use your ZX80 is a standard TV (color or black and white). The ZX80 comes complete with connectors that easily hook up to the antenna terminals of your TV. Also included is a connector for a portable cassette recorder, if you choose to store programs. (You use an ordinary blank cassette.)

The ZX80 is a family learning aid. Children 10 and above will quickly understand the principles of computing—and have fun learning.

Phone orders only: (203) 265-9171. We'll refund the cost of your call.
Information: General and technical—(617) 367-1988, 367-1909, 367-1898, 367-2555. Phones open Monday-Friday from 8 AM to 8 PM EST.

sinclair

Sinclair Research Ltd., 475 Main St., P.O. Box 3027, Wallingford, CT 06492.

To: **Sinclair Research Ltd., 475 Main St., P.O. Box 3027, Wallingford, CT 06492.**
Please send me _____ ZX80 personal computer(s) at $199.95* each (US dollars), plus $5 shipping. (Your ZX80 may be tax deductible.)
I enclose a check/money order payable to Sinclair Research Ltd. for $_____.

Name _____

Address _____

City _____ State _____ Zip _____

Occupation: _____ Age: _____

Intended use of ZX80: _____

Have you ever used a computer? ☐ Yes ☐ No.
Do you own another personal computer? ☐ Yes ☐ No. *For Conn. deliveries, add sales tax.

IA-12-0

The $149.95 personal computer.

Introducing the Sinclair ZX81

If you're ever going to buy a personal computer, now is the time to do it.

The new Sinclair ZX81 is the most powerful, yet easy-to-use computer ever offered for anywhere near the price: only $149.95* completely assembled.

Don't let the price fool you. The ZX81 has just about everything you could ask for in a personal computer.

A breakthrough in personal computers

The ZX81 is a major advance over the original Sinclair ZX80—the world's largest selling personal computer and the first for under $200.

In fact, the ZX81's new 8K Extended BASIC offers features found only on computers costing two or three times as much.

Just look at what you get:

- Continuous display, including moving graphics
- Multi-dimensional string and numerical arrays
- Mathematical and scientific functions accurate to 8 decimal places
- Unique one-touch entry of key words like PRINT, RUN and LIST
- Automatic syntax error detection and easy editing
- Randomize function useful for both games and serious applications
- Built-in interface for ZX Printer
- 1K of memory expandable to 16K

The ZX81 is also very convenient to use. It hooks up to any television set to produce a clear 32-column by 24-line display. And you can use a regular cassette recorder to store and recall programs by name.

*Plus shipping and handling. Price includes connectors for TV and cassette, AC adaptor, and FREE manual.

If you already own a ZX80

The 8K Extended BASIC chip used in the ZX81 is available as a plug-in replacement for your ZX80 for only $39.95, plus shipping and handling—complete with new keyboard overlay and the ZX81 manual.

So in just a few minutes, with no special skills or tools required, you can upgrade your ZX80 to have all the powerful features of the ZX81. (You'll have everything except continuous display, but you can still use the PAUSE and SCROLL commands to get moving graphics.)

With the 8K BASIC chip, your ZX80 will also be equipped to use the ZX Printer and Sinclair software.

Warranty and Service Program**

The Sinclair ZX81 is covered by a 10-day money-back guarantee and a limited 90-day warranty that includes free parts and labor through our national service-by-mail facilities.

**Does not apply to ZX81 kits.

NEW SOFTWARE: Sinclair has published pre-recorded programs on cassettes for your ZX81, or ZX80 with 8K BASIC. We're constantly coming out with new programs, so we'll send you our latest software catalog with your computer.

ZX PRINTER: The Sinclair ZX Printer will work with your ZX81, or ZX80 with 8K BASIC. It will be available in the near future and will cost less than $100.

16K MEMORY MODULE: Like any powerful, full fledged computer, the ZX81 is expandable. Sinclair's 16K memory module plugs right onto the back of your ZX81 (or ZX80, with or without 8K BASIC). Cost is $99.95, plus shipping and handling.

ZX81 MANUAL: The ZX81 comes with a comprehensive 164-page programming guide and operating manual designed for both beginners and experienced computer users. A $10.95 value, it's yours free with the ZX81.

The $99.95 personal computer.

Introducing the ZX81 kit

If you really want to save money, and you enjoy building electronic kits, you can order the ZX81 in kit form for the incredible price of just $99.95.* It's the same, full-featured computer, only you put it together yourself. We'll send complete, easy-to-follow instructions on how you can assemble your ZX81 in just a few hours. All you have to supply is the soldering iron.

How to order

Sinclair Research is the world's largest manufacturer of personal computers.

The ZX81 represents the latest technology in microelectronics, and it picks up right where the ZX80 left off. Thousands are selling every week.

We urge you to place your order for the new ZX81 today. The sooner you order, the sooner you can start enjoying your own computer.

To order, simply call our toll free number, and use your MasterCard or VISA.

To order by mail, please use the coupon. And send your check or money order. We regret that we cannot accept purchase orders or C.O.D.'s.

CALL 800-543-3000. Ask for operator #509. In Ohio call 800-582-1364. In Canada call 513-729-4300. Ask for operator #509. Phones open 24 hours a day, 7 days a week. Have your MasterCard or VISA ready.

These numbers are for orders only. For information, you must write to Sinclair Research Ltd., One Sinclair Plaza, Nashua, NH 03061.

sinclair

AD CODE 11BY

	PRICE†	QTY.	AMOUNT
ZX81	$149.95		
ZX81 Kit	99.95		
8K BASIC chip (for ZX80)	39.95		
16K Memory Module (for ZX81 or ZX80)	99.95		
Shipping and Handling	4.95		$4.95
To ship outside USA add $10.00			
		TOTAL	

MAIL TO: Sinclair Research Ltd., One Sinclair Plaza, Nashua, NH 03061.

NAME _____

ADDRESS _____

CITY/STATE/ZIP _____

†U.S. Dollars