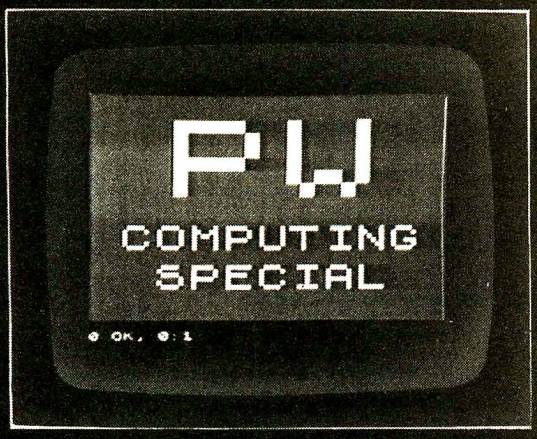


sinclair ZX COMPUTING FOR THE RADIO AMATEUR

80·81·SPECTRUM

CONTENTS

Introducing ZX Computing for the Radio Amateur	TWO
CALLSEARCH	THREE
LOGBOOK	THREE
Products	FOUR
OSCAR—RS ORBITS	FIVE
QTH LOCATOR—CONTEST SCORE	SIX
Win a Spectrum	SEVEN
Special Offer ZX81 Kit	TEN
DISTANCE—BEARING	ELEVEN
SPROG FINDER	TWELVE
Products	THIRTEEN
Products	FOURTEEN
1K MORSE TUTOR	FIFTEEN
16K MORSE TUTOR	FIFTEEN
COLOUR TEST PATTERNS	SIXTEEN
Video Output from a ZX81	SIXTEEN

INTRODUCING ZX COMPUTING TO THE RADIO AMATEUR

Many radio amateurs have an interest in computing, possibly via their work, but for many more a computer is something that is either very expensive or not of a great deal of interest. With the advent of the cheaper home computers, the Sinclair ZX80 was probably the first complete model ready to use at a price within the reach of most, the amateur with little or no interest in computers was able to afford to investigate the potential uses of such units in the shack.

This supplement is intended to give some idea of how useful a computer, especially the Sinclair ZX series, can be in running the shack. The ZX80, 81 and Spectrum computers were chosen as over the past few months the majority of programs received at the editorial offices have been written for these models. However, don't despair if you have a different make. It is possible to use the ideas contained in the programs and re-write them to run on your machine. The programs are written in Sinclair BASIC and can be translated into other dialects of BASIC.

What sort of uses can the amateur make of a computer in the shack? If you already have an RTTY terminal then you are making use of a computer dedicated to one specific task — encoding and decoding RTTY transmissions. The current rash of oriental black-box transceivers incorporate a microprocessor to control them as well as give a host of facilities such as scanning and memories.

However, none of these computers can be used for any other task and there are many that could be usefully performed by a computer to the benefit of the amateur.

Do you keep masses of magazines hoping that at some future date you will find the time to build a project or that you might find a particular article useful? How do you find one article from amongst the hundreds of magazines in the loft? A computer can give you the required information rapidly and accurately — the main problem being the amount of storage needed in the computer to contain the information. As we shall see later, the Spectrum range of accessories will shortly include a microdrive floppy disc with the potential of 100K bytes of storage.

With up to eight of these attached to your Spectrum you could have access to quite a large library listing, which you could search by subject matter, article title, author or any other way you felt might be useful.

How do you remember the details of past QSOs with the amateur you are working? Do you try searching through the logbook hoping to find his callsign while trying to hold an intelligible conversation? In this supplement you will find a program for the ZX81 +16K for carrying out a search of the file data held on other amateurs. With the ZX81 the amount of information storable is limited, but the program can be translated for the Spectrum and with the Microdrives the information stored can be increased considerably.

Following on from a callsign program the next stage is obviously some form of logbook. Again we are presenting a program for keeping a logbook which will even print out a hard copy of the selected entry. As this program is long and complex no program listing appears in this supplement. Instead the program is available only on the *PW* Radio Programs Cassette, details of which appear elsewhere. All the programs in the supplement are on the tape enabling you to load them easily into your ZX81 computer.

Are you into satellites? Your ZX81 can be used to give you orbit predictions at the press of a key without having to wait in the hope that the next GB2RS News will carry them.

These and many other uses are yours when you have a computer in the shack.

QRM

Of course, like most good things, there are snags. Most computers produce enormous amounts of r.f. interference and hence are not compatible with the amateurs' sensitive receivers. The ZX80, 81 and Spectrum are no exception, particularly as they are housed in plastics moulded cases offering no r.f. screening whatever.

You could put the computer inside a biscuit tin but obviously this would make operating the keys impossible. With the ZX81 most users will want to replace the keyboard with a better one fitted with "proper" keys and this offers the opportunity to house the p.c.b., power supply and keyboard in a grounded metal case. As with all forms of r.f.i. it is a case of trying different approaches and ideas until you achieve the desired level of suppression.

Modifications and Additions

The basic computer, as bought, imposes quite severe limitations on what you can do with it. After the initial learning period the need for extra memory, some form of hardcopy output and other interfaces becomes apparent. The ZX81, in particular, has an enormous following and many companies have designed and marketed all sorts of additional hardware, interfaces and software and it looks as if the Spectrum will attract a similar following.

Probably the number one extra for the ZX81 is a better keyboard to replace the rather awkward original. This is followed closely by extra add-on memory packs ranging from an additional 1K to 128K. We will look in detail at some of the available extras later on.

A small monitor to replace the domestic portable television not only gives an improved display but could also help with the domestic scene. The output from both the ZX80 and ZX81 can be easily modified to give both the original u.h.f. TV output and video for feeding a monitor set. Again details are to be found elsewhere in this supplement.

The ZX Range

Having discussed what we can do with a computer let us now look at the three models in the Sinclair ZX range, starting with the first model, the ZX80. This was possibly the first computer offered to the home enthusiast which was a computer and not just a p.c.b.-based development system. It also dramatically undercut the competition in terms of price. It is no longer manufactured and can be considered obsolete although it can still be used in a limited fashion for some of the simpler programs in this supplement.

ZX81

The ZX81 superseded the ZX80 and represented as big a step forward as the 80. Improvements were made in the memory available for actual use and the graphics capabilities. The keyboard was similar in style to the 80's and is probably the most criticised feature of the computer. However the price is considerably lower than its competitors and over 600 000 have been sold, not only in the UK but the USA and even Japan! A whole cottage industry has evolved around the ZX81 and the add-on units available continue to be added to, enabling more and more to be done with this popular computer.

ZX Spectrum

The Spectrum, as its name implies, offers the user colour graphics as well as sound and built-in memory of 16K or 48K. From the mechanical point of view the Spectrum's biggest difference to the ZX81 is the keyboard. Now we have distinct buttons which actually move downwards as the key is operated rather than little marked out areas which have no apparent movement. This overcomes the biggest problem with the ZX81, that of rapid and accurate entry from the keyboard. Like the 81, the Spectrum uses multiple shifts to give each of the 40 keys up to six different functions. The unique Sinclair BASIC is used with suitable changes and additions to suit the extra functions built into the Spectrum. The use of single stroke keywords is retained, making programming simple. Even if you do not use a colour TV or monitor the extra colour facility is still useful as the eight colours give a full range of greys between black and white.

The Spectrum is easy to use and offers the radio amateur several useful features, particularly if you are interested in ATV when it can provide a variety of useful video outputs ranging from testcards to message text in full colour. When the Microdrive floppy disc units become available the Spectrum will be able to store and retrieve large amounts of data at low cost, making it useful for library listings, searching through files of information on fellow amateurs and even logbook keeping, although *you will still need* to keep a logbook as we know it at present to comply with the licence conditions.

The Useful Tool

All in all, then, the addition of a computer to your equipment in the shack should be looked upon as acquiring a useful tool with which you can do a variety of jobs. You do not need to be a computer enthusiast, just as you do not have to be a motor mechanic to be able to get the best use out of a motor car.

CALLSEARCH

D. SMEE G6ENX

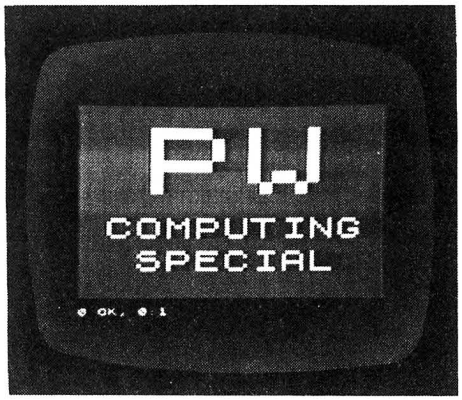
ZX81 +16K RAM

Callsearch is a sophisticated program written for the ZX81 +16K RAM expansion. The program is loaded into the computer from tape and immediately a prompt appears on the screen instructing the operator to set the tape recorder up so that it is ready for recording when instructions are given.

The computer then proceeds to ask for the callsign of the station being worked. If the ZX81 has information on file on the station then it displays it on the screen. If no information is stored a message to this effect is displayed and the operator is asked whether he wishes to store any information on the station. If the answer is yes the computer asks for the information to be input. At the end of the program the complete program and information is transferred onto the tape ready for the next time.

The information on a station can be updated or altered if desired and this program can form the basis of an extensive filing system limited only by the available storage capacity. Rewritten to run on a Spectrum equipped with Microdrive floppy discs the scope is almost limitless.

```
  10 LET A$="G6EKX■;PROGRAM WRI
TTEN BY D.SMEE"
  20 LET D=LEN A$
  29 CLS
  30 PRINT "PLEASE INPUT THE CAL
LSIGN OF THE STATION BEING WORKE
D. IF YOU WISH TO SAVE THE I
NFORMATION ALREADY FILED THEN I
NPUT A ""<>"" SIGN"
  40 INPUT B$
  43 CLS
  44 IF B$=">" THEN GOTO 700
  45 FAST
  50 LET C=LEN B$
  60 LET N=1
  70 IF A$(N)="*" THEN GOTO 100
  80 IF N=D THEN GOTO 500
  90 LET N=N+1
  95 GOTO 70
 100 IF CODE (A$(N+1))<>C THEN G
OTO 130
 110 LET H$=A$((N-C) TO N-1)
 120 IF H$=B$ THEN GOTO 160
 130 LET F=CODE A$(N+2)
 140 LET N=2+F+N
 150 GOTO 70
 160 SLOW
 169 CLS
 170 PRINT "THE INFORMATION ON "
;B$;" IS"
 180 LET G$=A$(N+3 TO (N+2+CODE
A$(N+2)))
 190 PRINT
 200 PRINT G$
 210 PRINT
 220 PRINT
 230 PRINT "WOULD YOU LIKE TO UP
DATE THIS INFORMATION ?(Y/N)"
 235 LET U=0
 240 LET G$=INKEY$
 250 LET U=U+1
 255 IF U=100 THEN PRINT "PLEASE
 PRESS ""Y"" OR ""N"""
 260 IF G$="" THEN GOTO 240
 270 IF G$<>"N" AND G$<>"Y" THEN
 GOTO 235
 280 IF G$="N" THEN GOTO 29
 285 CLS
 290 PRINT "PLEASE INPUT THE NEW
 INFORMATION ON ";B$
 300 INPUT I$
 310 LET NU=CODE A$(N+2)
 320 LET G=LEN I$
 340 LET A$=A$(1 TO N+1)+CHR$ (L
EN I$)+I$+A$(N+2+NU TO )
 350 LET D=LEN A$
 360 GOTO 29
 500 SLOW
 510 PRINT "THERE IS NO INFORMAT
ION ON "
 520 PRINT B$;" WOULD YOU LIKE T
O CREATE A FILE ON HIM ?(Y/N)"
 525 LET U=0
 530 LET G$=INKEY$
 540 LET U=U+1
```




```
 550 IF U=100 THEN PRINT "PLEASE
 PRESS ""Y"" OR ""N"""
 555 LET G$=INKEY$
 560 IF G$="" THEN GOTO 540
 570 IF G$<>"Y" AND G$<>"N" THEN
 GOTO 525
 580 IF G$="N" THEN GOTO 29
 585 CLS
 590 PRINT "PLEASE TYPE IN THE I
NFORMATION YOU WOULD LIKE TO STO
RE ON ";B$
 600 INPUT I$
 610 LET J$=B$+"*"+CHR$ C+CHR$ (
LEN I$)+I$
 620 LET A$=A$+J$
 625 LET D=LEN A$
 630 PRINT "INFORMATION SAVED"
 640 PAUSE 50
 650 GOTO 29
 670 SAVE "CALL"
 680 GOTO 29
 700 PRINT "PLEASE SET UP TAPE R
ECORDER"
 710 PRINT "AND PRESS ANY KEY WH
EN READY"
 720 PAUSE 40000
 730 SAVE "FIL■"
 740 CLS
 750 PRINT "********************
**********"
 760 PRINT "**********WRITTEN B
Y**********"
 770 PRINT "**********  D.SMEE
 **********"
 780 PRINT "**********  G6EKX
 **********"
 790 PRINT "********************
**********"
 800 PAUSE 250
 810 GOTO 29
```

LOGBOOK

D. SMEE G6ENX

ZX81 +16K RAM

Following on from Callsearch the next logical program development is a complete logbook program capable of storing, and retrieving, all the details that an amateur is required to keep under the conditions of his amateur radio licence.

The program, which is not listed here as it is a very long listing, is loaded from the *PW Radio Programs* cassette tape. The ZX81 will automatically run the program giving the necessary prompts and asking for details of the QSO in progress to be input. Hard copy can be obtained via the ZX Printer by keying the appropriate input letter and, after verifying that the information displayed on the screen is that which is required, pushing the key indicated by the computer to output the display on the screen onto the printer.

Obviously this type of print-out cannot replace the logbook as required by the Home Office, but the print-out could be used as a form of QSL card. Another use would be to use the video output to drive an ATV transmitter and so transmit the details of the QSO to the other station.

The Callsearch program could be used in a similar manner to transmit details of your station via your ATV equipment.

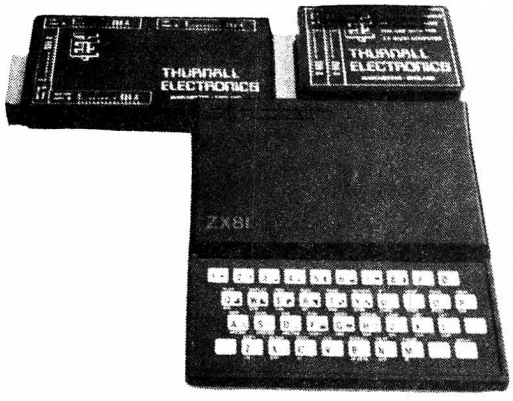
INPUT-OUTPUT PORT

The Thurnall Electronics TE10 Input-Output port for the ZX81 is based on the Z80APIO and provides sixteen programmable input-output lines divided into two 8 line ports A and B. The port plugs directly into the rear of the ZX81 and may be used with or without the 16K RAM and printer.

The port is input-output mapped, not memory mapped, hence there is no chance of clashing with other memory addresses. The port is controlled either from BASIC using a REM/POKE statement or directly from machine code. The port can be used simply in INPUT or OUTPUT modes or can be programmed in any combination up to 16 lines, in addition it can support Handshaking, Interrupt Control and Bit Control modes.

Using the port for RTTY transmissions will require the connection of a UART which is the easiest method of putting on start and stop bits as well as controlling the data transmission speed. The eight data lines are connected to the eight lines of port B and the control lines DS and TBMT are connected to lines 0 and 1 of port A. All inputs and outputs from the UART and the Input-Output port are TTL compatible. The UART clock is provided by a 555 timer chip.

The Input-Output port is available from **Thurnall Electronics, 95 Liverpool Road, Cadishead, Manchester M30 5BG.** Price is £14.95 in kit form less case and £17.95 assembled in a case. Full instructions and examples are provided.

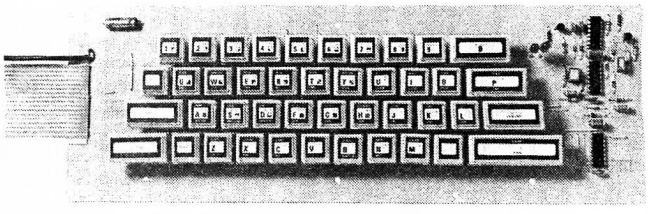


REPLACEMENT KEYBOARD

The main criticism of the ZX81 is its small and strange feeling keyboard. This can cramp the speed and accuracy of program and data entry.

There are numerous replacement keyboards available both ready assembled and in kit form some of which are simply replacement keys with a "normal" feel to them. Others have extra keys to improve input speeds.

The Maplin keyboard is of the latter type with extra keys for SHIFTLOCK, FUNCTION and GRAPHICS 2 modes. It is available either as a kit or ready assembled. We tried the kit version and found it to be easy to build with no major problems. The whole of the keyboard and extra electronics is contained on a single p.c.b. and the connections to the ZX81 are made via two ribbon cables and a screened lead for power. This is terminated in a 3·5mm jack which is plugged into a two-into-one adaptor (supplied) to pick up the raw 9V supply to the ZX81. The shape of the body of this adaptor prevented it being plugged into the socket on the side of the ZX81 as it fouled the plastics case.



The actual keyboard connections are made via two ribbon cables which are plugged into the two sockets used for the ZX81 keyboard tails. I had great difficulty in keeping the wire ends actually in the sockets and intend to change the sockets for either soldered joints or a totally different plug and socket system.

Maplin can also supply a suitable case which will also take the ZX81 p.c.b.

This keyboard performs very well allowing much improved entry while the extra keys certainly proved worthwhile.

Maplin Electronic Supplies Ltd., PO Box 3, Rayleigh, Essex SS6 8LR. Price in kit form £19.95 inc. VAT and carriage. Case £4.95.

INTERFACE CARD

Capital Computers produce an interesting serial input and output card for the ZX81. This card is a full specification Centronics parallel and RS232 serial input and output unit with an additional TTL level input and output. An on-board EPROM provides a comprehensive range of operating routines including BASIC program transfer either as tokens or as ASCII. The retail price of this card is £39.95 inc. VAT.

The company also produce a 16K RAM card and a program cartridge system for the ZX81. All of these products are being modified to work with the Spectrum, and Capital are also interested in manufacturing and marketing any products which *PW* readers may have developed for use with ZX81 and Spectrum computers.

Capital Computers Ltd., 1 Branch Road, Park Street, St. Albans, Herts.

SOUND with ZX-81!

MAKE AMAZING SOUND EFFECTS WITH YOUR ZX-81

£25.95 incl p&p & V.A.T. **THE ZON X-81**

- The ZON X-81 SOUND UNIT is completely self-contained and especially designed for use with the ZX-81. It just plugs in – no dismantling or soldering.
- No power pack, batteries, leads or other extras.
- Manual Volume Control on panel – ample volume from built-in loudspeaker.
- Standard ZX-81 – 16K Rampack or printer can be plugged into ZON X-81 Sound Unit without affecting normal ZX-81 operation.
- Huge range of possible sounds for games or: Music, Helicopters, Sci-Fi, Space Invaders, Explosions, Gun-shots, Drums, Planes, Lasers, Organs, Bells, Tunes, Chords etc., or whatever you devise!
- Uses 3-channel sound chip giving programme control of pitch, volume of tones and noise, all with envelope control.
- Easily added to existing games or programmes using a few simple "BASIC" lines.

FULL instructions with many examples of how to obtain effects and the programmes, supplied. Fully Guaranteed.

BI-PAK Dept. PW12, P.O. Box 6, 63A High Street, Ware, Herts.

BARCLAY VISA

Access & VISA accepted Ring 0920 3182 for immediate despatch.

```
ORBITAL INFORMATION FOR OSCAR 8

ENTER DAY MONTH YEAR  1. 11. 82

ENTER ORBIT NO.  23740

ENTER EQX HRS MIN SEC  5:13:52

ENTER DEG LONG WEST  151.85

ENTER NO. OF DAYS REQUIRED  1

IS INFORMATION OK YES OR NO.

SATELLITE EQX FOR OSCAR 8 DATED
1. : 11. : 82.

ORBIT.   HRS. MIN. SEC.   DEG W.

23740.   5 : 13 : 52      161.85
23741.   6 : 57 : 5       187.66
23742.   8 : 40 : 19      213.46
23743.   10 : 23 : 32     239.27
23745.   13 : 49 : 59     290.89
23746.   15 : 33 : 13     316.59
23747.   17 : 16 : 26     342.5
23748.   18 : 59 : 40     8.31

ENTER NEWLINE TO CONT: OR 2 COPY
OR BREAK TO STOP: OR N FOR NEW

SATELLITE EQX FOR RS 3=8 + OSCAR 8
DATED 1. : 11. : 82.

   ORBIT.   HRS. MIN. SEC.   DEG W.

3  3871.    1 : 0 : 45      313.66
   3872.    2 : 59 : 16     343.42

4  3843.    1 : 51 : 29     322.58
   3844.    3 : 50 : 52     352.56

5  3836.    2 : 5 : 6       326.6
   3839.    4 : 7 : 39      355.62

6  3865.    1 : 58 : 13     325.91
   3866.    3 : 56 : 56     355.72

7  3849.    1 : 2 : 20      310.55
   3850.    3 : 1 : 32      340.48

8  3831.    1 : 34 : 3      316.1
   3832.    3 : 33 : 49     345.17

08 23740.   5 : 13 : 52      161.85
   23741.   6 : 57 : 6       187.66

BEAM HEADING 120 DEGREES

BELOW HORIZON : OUT OF RANGE

THE ORBIT PATH FOR OSCAR 8
REF EQUATOR DEG LONG WEST 322

AT 10 MINS AFTER EQX OSCAR 8 IS
LOCATED AT

34 DEG LAT          330 DEG LONG
```

OSCAR—RS ORBITS

N. DILLEY G8YBT

ZX81 +16K RAM

This program provides easy access to the orbital information for the RS and OSCAR satellites. The program was designed around the need to provide a neat display of the orbital information for a complete day showing date, orbit number, time at EQX and degrees longitude west at EQX. It had to exclude orbits not within the map range and be capable of selecting RS3 to RS8 and OSCAR 8 satellites.

The program listing is not reproduced here but is on the *PW* Radio Programs Cassette to give easy loading of the program into the ZX81.

Data Entry

Line 25: The start of the program requires the user to select the satellite to be processed. It must be noted that the input variable will only accept the wording and spacing exactly as listed on the screen.

Line 180: To enable the program to calculate the orbits it is necessary to input the information shown on the screen. When entering the day, month and year care must be taken to enter these three input variables separately. The same also applies to the hours, minutes and seconds of the time.

The number of days routine allows the program to run, pausing for ten seconds until the appropriate date is reached. If the information is correct according to the program a "YES" will start the calculation. A "NO" will interrupt the program and the data can be corrected.

Line 370 and Lines 475 to 490: This is the display sequence which should appear as shown at the top of the printout on the left.

When the appropriate date is reached the program requires instructions to continue. The choices are shown. If NEWLINE is used to continue the computer will again ask how many days you wish the program to run for. The input "Z" is needed to make a hardcopy of the printout and again you will be asked to make the same choices. Input "N" will return the program to the start to allow you to select another satellite.

A reference orbit for each satellite is shown dated for 1 November 1982 to give the data needed to run the program.

The program also tracks the chosen satellite as it orbits the earth. This facility is very useful as it starts giving beam headings as soon as the satellite is within 5 degrees latitude of your map area. This gives you time to swing your beam onto the correct heading to acquire the satellite. As soon as the satellite comes over your horizon, and therefore within range, the computer gives the azimuth angle as well as beam heading and tracks the satellite across the sky at one minute intervals until it disappears over the other horizon and passes out of range.

This program can be left running continuously if desired to give a continuous track of the satellite and allowing you to work stations from countries across the equator for instance. The beam heading given before the satellite comes over the horizon allows you to be well prepared with the beam pointing in exactly the right direction to allow you to work the satellite at very low angles.

Line 1000 starts this part of the program with the ZX81 asking for you to ENTER DEG LONG WEST followed by ENTER MINS AFTER EQX (Equatorial crossing). This data is taken from the calculator part of the program or from tables and then pressing R will start the computer tracking. With the satellite out of range and below the horizon the computer will display this fact on the screen. As soon as the satellite comes within 5 degrees lat. of your horizon the bearing will be displayed on the screen followed by azimuth angle when in range.

```
  10 REM ▓▓▓
```

WIN A 16K ZX SPECTRUM COMPUTER

The radio enthusiast can find many uses for a home computer around the shack. The Sinclair ZX Spectrum, with its graphics colour capabilities and 16K store is finding increasing use among radio amateurs, and for our competition Sinclair Research have donated a 16K Spectrum, currently selling at £125, for the first prize.

Just miss the first prize and you could win one of the five runners-up prizes of a free subscription to *Practical Wireless* for one year.

HOW TO ENTER

Mr A has been interested in radio since boyhood and obtained his Class A amateur licence about twenty years ago. He has an understanding wife and three children who are not interested in radio but enjoy science subjects at school.

Mr A builds a lot of his own equipment, especially antennas and TV gear. His main interests are in h.f. working particularly c.w. and RTTY.

For our competition you have to decide which eight computer programs out of the sixteen listed on the entry coupon would, together, be of most use to Mr A in pursuing his hobby. Place a cross (X) in ink, against each of the eight you select. No order of importance is needed — just eight crosses.

Complete the coupon with your full name and address, and post it in a sealed envelope to: *Practical Wireless* ZX Spectrum Competition, 55 Ewer Street, London SE99 6YP, to arrive not later than Friday 31 December 1982.

RULES

There is no entry fee but each attempt must be on a proper entry coupon cut from *Practical Wireless* and must bear the entrant's own name and address.

All accepted entries will be examined, and the first prize will be awarded to the entrant who, in the opinion of the judges, has shown the greatest skill and judgement in selecting the best collection of eight computer programs for Mr A. The remaining prizes will be awarded for the next best attempts in order of merit. No entrant may win more than one prize.

In the event of a tie for any prize(s), those tying will take part in a further test of skill to be held by post, to determine such winner(s) or winning order.

Entries arriving after the closing date will not be considered and no responsibility can be accepted for any entries lost or delayed in the post or elsewhere. Any entries received incomplete, illegible, mutilated, altered or not complying exactly with the instructions and rules will be disqualified.

Decisions of the judges, and of the Editor in all other matters affecting the competition, will be final. No correspondence will be entered into. Entry implies acceptance of the rules as final and legally binding.

The competition is open to all readers in Great Britain, Northern Ireland, the Channel Isles and Isle of Man other than employees (and their families) of IPC Magazines Ltd., Sinclair Research and the printers of *Practical Wireless.*

Winners will be notified, and the result will be published later in *Practical Wireless.*

ENTRY COUPON

PW SPECTRUM COMPETITION

Place a cross (X) in ink against each of the EIGHT programs you select.

MORSE TUTOR		CONTEST SCORING	
OHMS LAW		CALLSIGN FILE	
OSCAR ORBIT PREDICTIONS		LOGBOOK	
QTH LOCATOR		RTTY TERMINAL	
SPURIOUS (SPROG) FINDER		TECHNICAL ARTICLE INDEX	
ATV TEST CARD		RESONANT CIRCUITS	
ATV TEXT GENERATOR		HIGH SPEED MORSE TERMINAL	
BEARINGS & DISTANCE		TELEPHONE DIRECTORY	

In entering this competition, I agree to abide by the rules and to accept the published result as final and legally binding.

NAME (Mr/Mrs/Ms) .....

ADDRESS .....

.....

.....

PLEASE CUT NEATLY AROUND THIS LINE

Sinclair ZX Spectr

16K or 48K RAM... full-size moving-key keyboard... colour and sound... high-resolution graphics...

From only £125!

First, there was the world-beating Sinclair ZX80. The first personal computer for under £100.

Then, the ZX81. With up to 16K RAM available, and the ZX Printer. Giving more power and more flexibility. Together, they've sold over 500,000 so far, to make Sinclair world leaders in personal computing. And the ZX81 remains the ideal low-cost introduction to computing.

Now there's the ZX Spectrum! With up to 48K of RAM. A full-size moving-key keyboard. Vivid colour and sound. High-resolution graphics. And a low price that's unrivalled.

Professional power–personal computer price!

The ZX Spectrum incorporates all the proven features of the ZX81. But its new 16K BASIC ROM dramatically increases your computing power.

You have access to a range of 8 colours for foreground, background and border, together with a sound generator and high-resolution graphics.

You have the facility to support separate data files.

You have a choice of storage capacities (governed by the amount of RAM). 16K of RAM (which you can uprate later to 48K of RAM) or a massive 48K of RAM.

Yet the price of the Spectrum 16K is an amazing £125! Even the popular 48K version costs only £175!

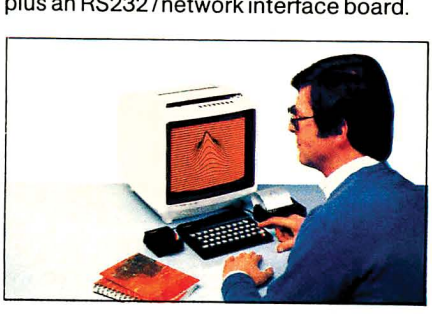
You may decide to begin with the 16K version. If so, you can still return it later for an upgrade. The cost? Around £60.

Ready to use today, easy to expand tomorrow

Your ZX Spectrum comes with a mains adaptor and all the necessary leads to connect to most cassette recorders and TVs (colour or black and white).

Employing Sinclair BASIC (now used in over 500,000 computers worldwide) the ZX Spectrum comes complete with two manuals which together represent a detailed course in BASIC programming. Whether you're a beginner or a competent programmer, you'll find them both of immense help. Depending on your computer experience, you'll quickly be moving into the colourful world of ZX Spectrum professional-level computing.

There's no need to stop there. The ZX Printer – available now – is fully compatible with the ZX Spectrum. And later this year there will be Microdrives for massive amounts of extra on-line storage, plus an RS232 / network interface board.



Key features of the Sinclair ZX Spectrum

- Full colour – 8 colours each for foreground, background and border, plus flashing and brightness-intensity control.
- Sound – BEEP command with variable pitch and duration.
- Massive RAM – 16K or 48K.
- Full-size moving-key keyboard – all keys at normal typewriter pitch, with repeat facility on each key.
- High-resolution – 256 dots horizontally x 192 vertically, each individually addressable for true high-resolution graphics.
- ASCII character set – with upper- and lower-case characters.
- Teletext-compatible – user software can generate 40 characters per line or other settings.
- High speed LOAD & SAVE – 16K in 100 seconds via cassette, with VERIFY & MERGE for programs and separate data files.
- Sinclair 16K extended BASIC – incorporating unique 'one-touch' keyword entry, syntax check, and report codes.

um

RS232/network interface board

This interface, available later this year, will enable you to connect your ZX Spectrum to a whole host of printers, terminals and other computers.

The potential is enormous. And the astonishingly low price of only £20 is possible only because the operating systems are already designed into the ROM.

ZX Spectrum

Available only by mail order and only from

sinclair

Sinclair Research Ltd,
Stanhope Road, Camberley,
Surrey, GU15 3PS.
Tel: Camberley (0276) 685311.

The ZX Printer – available now

Designed exclusively for use with the Sinclair ZX range of computers, the printer offers ZX Spectrum owners the full ASCII character set – including lower-case characters and high-resolution graphics.

A special feature is COPY which prints out exactly what is on the whole TV screen without the need for further instructions. 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 ZX Spectrum. A roll of paper (65ft long and 4in wide) is supplied, along with full instructions. Further supplies of paper are available in packs of five rolls.

The ZX Microdrive – coming soon

The new Microdrives, designed especially for the ZX Spectrum, are set to change the face of personal computing.

Each Microdrive is capable of holding up to 100K bytes using a single interchangeable microfloppy.

The transfer rate is 16K bytes per second, with average access time of 3.5 seconds. And you'll be able to connect up to 8 ZX Microdrives to your ZX Spectrum.

All the BASIC commands required for the Microdrives are included on the Spectrum.

A remarkable breakthrough at a remarkable price. The Microdrives are available later this year, for around £50.

How to order your ZX Spectrum

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, Barclaycard, Access or Trustcard.

EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option, of course. 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 ZX Spectrum – 16K RAM version	100	125.00	
	Sinclair ZX Spectrum – 48K RAM version	101	175.00	
	Sinclair ZX Printer	27	59.95	
	Printer paper (pack of 5 rolls)	16	11.95	
	Postage and packing: orders under £100	28	2.95	
	orders over £100	29	4.95	
			Total £	

Please tick if you require a VAT receipt ☐

*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

Signature

PLEASE PRINT

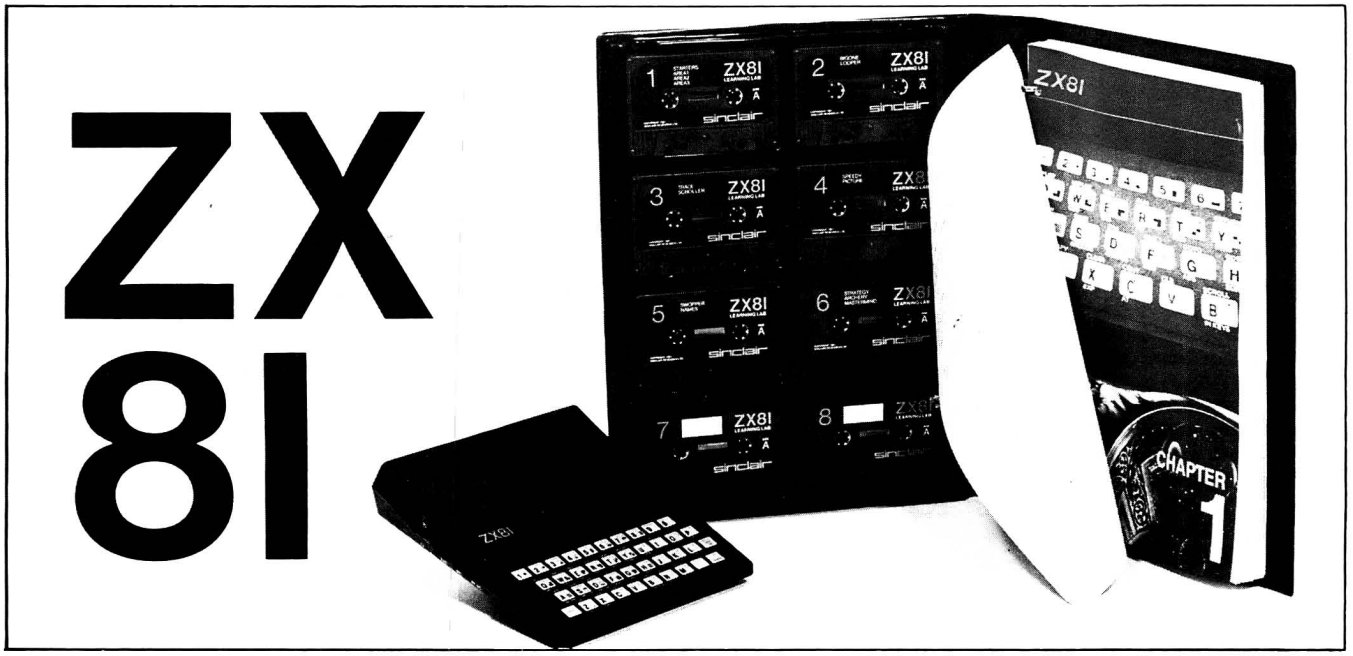
Name: Mr/Mrs/Miss

Address

PRW 812

FREEPOST – no stamp needed. **Prices apply to UK only.** **Export prices on application.**

special offer



This is probably your last chance to buy the ZX81 in kit form. *Practical Wireless* has negotiated with Sinclair Research for the last 100 ZX81 kits to be reserved for *PW* readers at the low price of £32.90.

Now you can afford to have a ZX81 just for the use in the shack and let the kids have the family model for Space Invaders.

The kit is straightforward to build and is supplied with all leads, assembly instructions and ZX81 Manual. The power supply is not supplied with the kit.

For those readers who do not want to assemble a kit or who would like to learn more about programming the ZX81 we have also negotiated with Sinclair a special offer comprising a complete ZX81, with power supply, and the ZX81 Learning Lab at the special price of £55.90. The Learning Lab takes you through programming the ZX81 step-by-step with the aid of six pre-recorded cassettes and a comprehensive manual. Two blank cassettes are also supplied to allow you to save your own programs.

The Learning Lab plus ZX81 offer has no restrictions on availability but the ZX81 Kit offer is, unfortunately, strictly limited to the first 100 orders received. ZX81s are made in the UK.

HOW TO ORDER

Fill in both parts of the coupon with your name and full postal address in BLOCK LETTERS and send them with your crossed cheque or postal order(s) made payable to Sinclair Research (your name and address on the back please) to *Practical Wireless*, Dept ZX Offer, Westover House, West Quay Road, Poole, Dorset BH15 1JG. If you are applying for **one** of the 100 Kits a stamped address envelope must be enclosed with your coupon to enable us to either confirm your order or refund your cheque if you are not in the first 100 applications.

Only available while stocks last to readers of *PW* in England, Scotland, Wales and N. Ireland. Not available in Eire, Channel Islands or overseas. Orders are normally despatched within 28 days, but please allow time for carriage. Closing date is 28th February 1983, subject to availability.

A Division of IPC Magazines Ltd., Kings Reach Tower, Stamford Street, London SE1 9LS (Reg. No. 53626 England)

To: PRACTICAL WIRELESS
ZX81 Offer, Westover House, West Quay Road, Poole, Dorset BH15 1JG

Please send me a ZX81 Kit @ £32.90/ZX81 plus Learning Lab @ £55.90, including P&P, as indicated below.

I enclose P.O./Cheque No. ..... **Value** .....

ZX81 Kit (1 per reader) ☐ SAE enclosed ☐

Number of ZX81 + Learning Labs ☐

Name .....

Address .....

.....

.....

Tel. No. (Home or Work) .....

ZX81 Kit ☐ SAE enclosed ☐

Number of ZX81 + Learning Labs ☐

Name .....

Address .....

.....

From PRACTICAL WIRELESS, ZX81 OFFER, Westover House, West Quay Road, Poole, Dorset BH15 1JG.

CUT ROUND DOTTED LINE

```
  10 LET F=PI/180
  20 PRINT "HOME"
  30 GOSUB 200
  40 LET X=E
  60 GOSUB 200
  70 LET B=COS N*COS Y*COS (E-X)
+SIN N*SIN Y
  80 PRINT "DX=";6367*ACS B,
  90 LET A=SIN N-B*SIN Y
 100 LET B=ATN (SIN (E-X)*COS N*
COS Y/A)+PI*(A<0)
 110 PRINT "AZ=";(B+(PI+PI)*(B<0
))/F
 120 GOTO 60
 200 PRINT "LAT DEG"
 210 INPUT N
 220 PRINT "MIN"
 230 INPUT A
 240 PRINT "N/S"
 250 INPUT N$
 260 PRINT "LONG DEG"
 270 INPUT E
 280 PRINT "MIN"
 290 INPUT B
 300 PRINT "E/W"
 310 LET N(K)=M
 320 CLS
 330 PRINT N;"-";A;"";N$,E;"-";B
;"";E$
 340 LET N=F*(N+A/60)
 350 IF N$="S" THEN LET N=-N
 360 LET E=F*(E+B/60)
 370 IF E$="W" THEN LET E=-E
 380 RETURN
```

DISTANCE & BEARING

J. MORRIS G4ANB
P. BURDEN G3UBX

ZX81–ZX80 +8K ROM

This program is straight-forward and gives the great circle distances and bearings between (nearly) any two points on the surface of the earth. The program first asks for the latitude and longitude, both expressed in degrees and minutes, of the "home" station. It then asks for the position of the "distant" station, expressed in the same manner. When all of the information has been typed in the program prints the great circle distance in kilometres between the two stations and the bearing from the "home" to "distant" location. After this a new "distant" location can be typed in to give a new distance and bearing calculation, and the whole process repeated.

The program has one subroutine, lines 200 to 380, which is used for data input. Lines 200 to 250 consist of pairs of PRINT and INPUT statements which prompt for and fetch the degrees and minutes of the latitude and either "N" for north or "S" for south. Lines 260 to 310 make up a similar series to get the longitude, including "E" for east or "W" for west.

Line 320 clears the screen so that the PRINT statement in line 330 puts the values which have just been typed in at the top of the screen. Line 340 takes the degrees and minutes of the latitude and converts them to a figure in radians, which is saved in variable N. F is a conversion factor which is assumed to have been set to PI/180 before the subroutine was called. If the latitude was specified as south of the equator line 350 makes N negative. Lines 360 and 370 are very similar, and result in E being set to the longitude, in radians east of Greenwich. Line 380 marks the end of the subroutine with a RETURN to the main program.

To summarise, the subroutine takes a position, typed in as degrees and minutes on the keyboard; clears the screen and prints out the input data; and finally sets N and E to the latitude and longitude in radians north of the equator and east of Greenwich respectively.

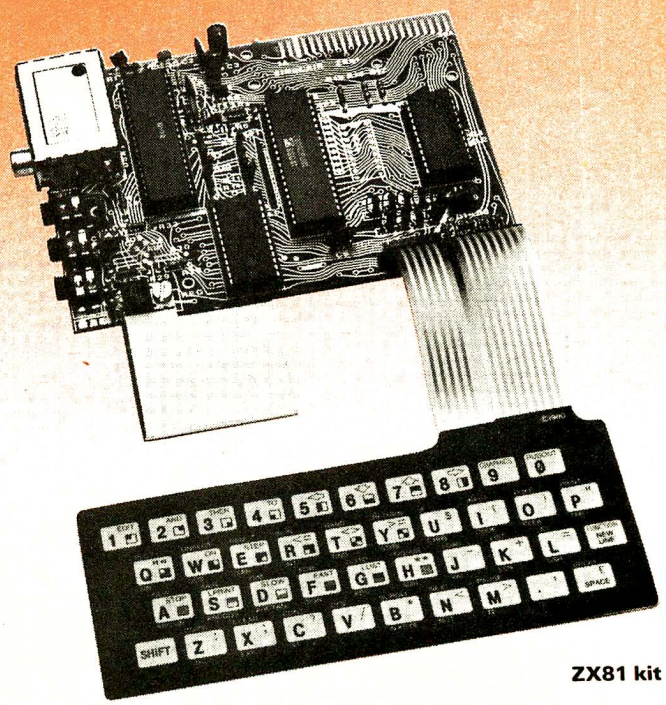
Returning to the main program, the first step is to set F to the degrees to radians conversion factor needed by the subroutine, in line 10. The next stage is to get the "home" latitude and longitude, and so line 20 prints an appropriate prompt and line 30 calls the subroutine to get the data. The subroutine leaves values in N and E, and so these are copied into X and Y for later use in lines 40 and 50.

Line 60 starts the main program loop by calling the subroutine to get the "distant" location. A standard formula is applied in line 70 to set B to the cosine of the "central angle" between the two stations. This is the angle between the lines from the centre of the earth to the two locations. Taking arc-cosine of B and multiplying by the radius of the earth gives the great circle distance. This is done in line 80 and the result printed out with an appropriate label.

Another standard formula, specially tailored for ZX81 BASIC, is applied in lines 90 and 100 to give the bearing. The formula uses the ATN function, which on the ZX81 always gives a result in the range –PI/2 to PI/2 (–90° to 90°). Obviously the bearing of any station to the south is going to be outside these limits, and so the expression PI*(A<0) is included to take care of this. In line 110 the bearing is printed out with the label "AZ", short for azimuth. The slightly complicated expression in the PRINT statement merely assures that the bearing is positive by adding 2*PI if it starts off negative; and then converts from radians to degrees using F, the conversion factor set in line 10. Line 120, the final statement of the main program, causes a jump back to the start of the loop at line 60, ready for the next calculation.

Using the program is simplicity itself. Once it is loaded, press RUN and the prompt "HOME LAT DEG" should appear. Type in the degrees part of your home latitude, and press NEWLINE. Then the program will prompt "MIN" to which you should respond with the minutes of your latitude. Next will come "N/S" to which the answer should be "N" if you are north of the equator and "S" if south. A very similar sequence is used to set the longitude. After doing this the figures just typed in are printed out and can be checked. The process is then repeated for the "distant" station, following which the distance and bearing are printed. The ZX81 is then ready for the position of a new "distant" station to be typed in.

The program is fairly "bomb-proof" in normal use but will crash in certain special circumstances. In particular, the program will halt with report 6/100 if the two locations are *exactly* on opposite sides of the earth, or if they are both on the equator. In the former case *all* bearings are equally correct, and in the latter the bearing will be 90° or 270°. In both cases the distance will be calculated correctly. Unfortunately, the very cases which can cause a crash are those most likely to be used in program testing! However, they should very seldom arise in real calculations. If the program does crash it can be restarted at the point of inputting the location of the "distant" station by GOTO 60.



ZX81 kit

SPROG FINDER

J. MORRIS G4ANB
P. BURDEN G3UBX

ZX81—ZX80 +8K ROM

Do you want to track down that annoying "whistle", "birdie", "sprog", or more properly but less descriptively "spurious response" in your receiver? Spurious responses have plagued radio operators ever since the invention of the superheterodyne receiver. The image response of a simple superhet is well known and easily calculated. In more complex multiple i.f. transmitters and receivers with several oscillators things are not so simple, and it can be very difficult to track down the source of a particular "sprog".

This program helps by using the tireless high-speed arithmetic capability of the computer to try every possible combination of the various oscillator frequencies and their harmonics. It starts by considering only the fundamental frequencies, adding and subtracting them in every conceivable way and comparing the result with the actual spurious response frequency. If a match is found the combination is printed out and the program carries on searching. Once all of the combinations involving only the fundamental frequencies have been exhausted the second harmonics are included in the calculation. When this series is exhausted the third harmonics are introduced, and so on. In fact the program will run for ever, trying less and less likely combinations, until it is stopped from the keyboard.

The program falls naturally into 7 sections, and these are distinguished in the listing by the "hundreds" of the line numbers. Lines 10 to 50 form the introductory section. After a short prompt from line 10 the number of frequencies involved, F, is set by the INPUT in line 20. Arrays O and N are set to this size. O is used to hold the oscillator frequencies and N keeps the harmonics being considered. The constant "1" is used many times in the program and so U is set to this value to save memory space. (This may seem odd at first sight, but a constant is held in the ZX81 memory as its character representation followed by another half-a-dozen hidden bytes containing the binary value; so that an innocent looking "1" in a program can actually eat up a significant amount of memory.)

Lines 100 to 140 make up a loop prompting for, inputting and printing the oscillator frequencies. It does not matter what units the frequencies are specified in, as long as they are all the same; such as all in MHz or all in kHz.

The frequency of the spurious response is set in lines 200 to 250. It would be unwise to specify a single frequency, as inaccuracies and rounding errors would make an exact match very unlikely. Instead a range of frequencies is set by giving a low limit, L, and a high limit, H. Line 260 gives M the initial value one. M is used to hold the maximum harmonic which will be considered.

Each element of the "harmonic array", N, is set to this value in lines 300 to 320. Line 300 marks the start of the main section of the program.

Lines 400 to 430 set P to the product frequency of mixing together the current harmonics of all of the oscillators. This is our trial spurious response which will be compared with the real spurious response. Before doing that, however, lines 440 and 450 check to see if any key is being held down. If not the program goes on its way in FAST mode, calculating its heart out. If a key is pressed, SLOW mode is set so that the screen can be examined for any results so far. When the key is released FAST mode will come back on the next pass through the loop, so keeping the search going as rapidly as possible.

Lines 500 to 560 form the print-out section. Line 500 checks to see if the possible spurious response just calculated is within the range of interest. If not the print section is skipped. If the response is within range the actual frequency is printed out followed by the components making it up. The print line is organised as an equation, using "+", "*" and "=". For example, a line reading: 1.4=−3*0.2+2*1.0 would mean that a spurious response at 1·4MHz *could* come from the 3rd harmonic of a 0·2MHz oscillator mixing with the 2nd harmonic of a 1MHz oscillator. "Zero harmonics" are included in the calculation to allow for the case where there are several oscillators but not all of them take part in the production of a given spurious response. Any zero harmonics are suppressed in the print-out by line 540.

```
 10 PRINT "FREQS"
 20 INPUT F
 30 DIM N(F)
 40 DIM O(F)
 50 LET U=1
100 FOR K=U TO F
110 PRINT "F";K;"=";
120 INPUT O(K)
130 PRINT O(K)
140 NEXT K
200 PRINT "LO=";
210 INPUT L
220 PRINT L
230 PRINT "HI=";
240 INPUT H
250 PRINT H
260 LET M=U
300 FOR K=U TO F
310 LET N(K)=M
320 NEXT K
400 LET P=0
410 FOR K=U TO F
420 LET P=P+O(K)*N(K)
430 NEXT K
440 IF INKEY$="" THEN FAST
450 IF INKEY$<>"" THEN SLOW
500 IF P<L OR P>H THEN GOTO 600
510 PRINT P;"=";
520 FOR K=U TO F
525 IF N(K)>0 THEN PRINT "+";
530 IF SGN N(K) THEN PRINT N(K)
;"*";O(K);
540 NEXT K
550 PRINT
600 FOR K=U TO F
610 LET N(K)=N(K)-U
620 IF N(K)>=-M THEN GOTO 400
630 LET N(K)=M
640 NEXT K
650 LET M=M+U
660 GOTO 300
```

LIne 600 to 640 select the next harmonic set. This is done by lowering the harmonic number of the first frequency until it passes −M. (Negative as well as positive harmonics are considered to allow for subtractive as well as additive mixing.) When the first oscillator harmonic goes below −M it is reset to +M and the harmonic of the second oscillator reduced by one. If this passes the lower limit it is similarly reset and the next harmonic number reduced, and so on until every possible combination has been covered. The FOR—NEXT loop in lines 600 to 640 is usually abandoned before it has terminated normally, control being passed to the product calculation. The only time line 650 is executed is when every combination of harmonics up to the maximum, M, has been tried. Line 650 then increases the maximum harmonic and line 660 sends the program back to start scanning all over again.

Use of the program is quite simple and should be evident from the above description. Be warned, however, that because the program is quite exhaustive in its search, trying each and every combination, it can take quite a while to run, especially if there are several oscillators and the harmonics involved are high. A good plan is to set the program running, type in the data, and leave it. Switch the television off, and let the ZX81 chunter away to itself. This way you can go out for the evening and quite honestly claim that the whole evening was spent tracking down an elusive sprog!

To give an example (which actually occurred), a TS-700 144MHz transceiver was being used with a Microwave Modules 144-432MHz transverter and a strong "birdie" could be heard when the receiver was tuned to 145·045MHz on u.s.b. Where did it come from? The transverter has two oscillators, one at 116MHz and the other at 101MHz. Inside the TS-700 things are a bit more complicated, there being three oscillators. The first is the v.f.o., which tunes from 8·2 to 9·2MHz, and so when the receiver is set to 145·045MHz the v.f.o. must be at 8·245MHz. That is our third frequency. The v.f.o. output is mixed with a 126·109MHz signal from a crystal oscillator so giving the fourth frequency. The fifth and final oscillator is also crystal controlled: the 10·6985MHz carrier oscillator.

These five frequencies are fed into the program. The spurious response has to be coming down the i.f. strip to be detected and the nominal i.f. frequency is 10·7MHz. To allow a bit of elbow room the high and low limits are set at 10·65 and 10·75MHz. The result, after about ten minutes, is discussed below.

It seems that the second harmonic of the 116MHz oscillator is mixing with the 101MHz in the transverter to give 131MHz, which is probably travelling down the lead to the TS-700. In the TS-700 the carrier oscillator, second harmonic of the v.f.o, 126·109MHz conversion oscillator, and stray 126MHz from the transverter are all mixing together to give 10·6825MHz. This is only 12·5kHz away from the nominal i.f. and the difference could well be due to one or more of the crystals not being quite spot on. This may not be the actual cause of the "birdie", but it is plausible as a first line of investigation.

Notice how the program also finds the carrier oscillator itself, at 10·6985MHz. Although this comes within the constraints of the program this "trivial" solution would actually be ignored.

TTY INTERFACE

Softest have developed a low-cost interface for both the ZX81 and Spectrum computers to give the user hard-copy output on a Teletype printer. The interface is supplied complete with machine code driver for printing ASCII characters and requires a 9V 20mA supply (PP3 battery). The unit also takes less than 100mA from the computer itself.

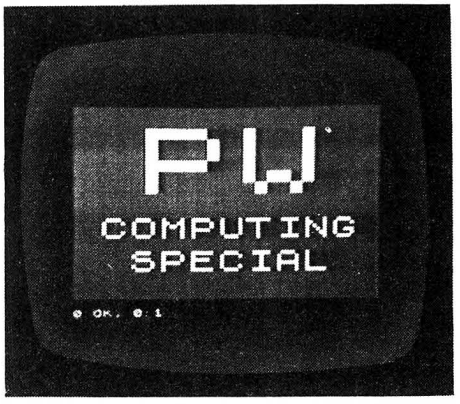
Interfacing the computer to a 20mA current loop driven Teletype the unit gives hard-copy across 72 characters on plain paper. The software supplied generates the coded serial bit stream for actually driving the Teletype. Written in machine code it is provided as a listing. The programs are called as USR routines and characters placed in specified locations are sent to the Teletype at 110 baud.

The hardware is a compact potted assembly with all connectors supplied. The Teletype is connected via a simple terminal block and the interface plugs into the rear of the computer.

The price of both versions is £9.50 post free with the BASIC listing on cassette for the Spectrum costing an extra £2.50.

Softest can also supply a Rapid Reference Series of booklets on ZX81 BASIC and Machine Code and a cassette with a ZX81 test program.

Softest, 10 Richmond Lane, Romsey, Hants SO5 8LA.



PORTABLE CASES

Kalenia Wood Products custom-built operating centres and carrying cases are strongly constructed to make your Sinclair ZX computer system fully portable. Foam sponge protects and holds the computer and its accessories in position and with the lift-off lid removed the unit becomes an ideally laid-out computing centre. The cases are made from Birch plywood and finished in the manner of traditional scientific instrument cases. ZX81 case £21.00, Spectrum case £22.00 inc. VAT and post and packing.

The ZX81 case is 483 x 279 x 95mm and holds ZX81, Sinclair 16K RAM, power supply, leads, manual, software and cassette recorder. A ZX Printer can be substituted for the tape recorder for an extra £1.50.

The Spectrum case is 534 x 299 x 95mm and holds Spectrum, power supply, leads, manual, software, cassette recorder, ZX Printer and ZX Microdrive.

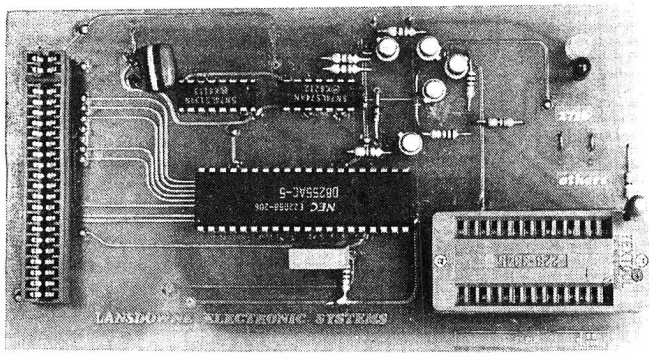
Kalenia Wood Products, 4–6 Auckland Street, Burslem, Stoke-on-Trent ST6 2AX.

EPROM PROGRAMMER

With the increased use of the ZX81 by radio amateurs, many of them are finding the operating speed of the Sinclair BASIC very slow. Machine code is much faster, more economical in the use of memory and can be POKED in by a BASIC program, but a better storage medium is an EPROM. Once a program is stored in an EPROM it is simply accessed by a USR command. There is no need for the long wait, sometimes in vain, for a program to be loaded from a cassette. A fast restart in the case of a "white-out" is also enabled.

The programmer will program 2716–2732 and 2764 EPROMS under software control. The EPROM being programmed is held in a high-quality 28 pin ZIF socket for ease of insertion and removal. The control software is supplied on a cassette and, in case of failure to load, as a listing. For programming a 27 to 30V power supply is required, easily obtained by connecting three PP3 batteries in series. Price £46.00 inc. VAT.

Lansdowne Electronic Systems, Unit 21, Borough Road Industrial Estate, Steeplejack Way, Darlington, Co. Durham DL1 1TG.



REDDITCH ELECTRONICS

21 FERNEY HILL AVENUE
REDDITCH WORCS B97 4RU

ZX81 HARDWARE

(postage 40p under £4)

Keyboard	kit	**£17.00**
	built	**£20.00**
In/out Port	kit	**£16.95**
	built	**£18.95**
Music Board	kit	**£16.95**
	built	**£18.95**
Female Connector 23 way		**£2.50**
Male Connector 23 way		**£1.60**

SPECTRUM HARDWARE

Connectors etc. See catalogue.
Send stamped envelope for free catalogue.

ADD-ON SOUND UNIT

Bi-Pak Semiconductors are marketing a unit which plugs into the rear of a ZX81 to give facilities for generating a wide range of sound effects under program control.

The unit is based on a three-channel plus noise sound effects i.c. and is so designed that the pitches and volumes of the three channels and the overall attack and decay envelope can be controlled by simple BASIC statements. Although the main application of the ZonX-81 is to add sound to games it could be programmed to produce Morse Code under direct programme control.

No soldering is needed to install the ZonX-81, all power supplies etc being taken direct from the ZX81's rear socket. The module is housed in a black plastics case with a manual volume control and built-in loudspeaker. A 16K RAM or any other add-on unit can be plugged into the rear of the ZonX-81.

A comprehensive instruction booklet takes the user through the operation of the unit and includes a number of sample programs. I did find however that the booklet needed very careful reading before I got the hang of using the programs.

The ZonX-81 costs £25.95 incl. VAT and postage from **Bi-Pak Semiconductors, PO Box 6, Ware, Herts.**

ZX81 AUDIO CONTROLLER

The Abacus Electronics controller eliminates the tedious swapping of plugs when saving and loading programs on cassette. The built-in microphone/speaker on the ZX81 version gives fast and reliable cueing and naming of programs. It can also be used as the output for the two Morse Tutor programs listed in this supplement. A single switch selects TALK, SAVE, CUE and LOAD modes. The Spectrum version has single switch selection of SAVE, LOAD and AMP modes, the built-in amplifier and loudspeaker boosts the Spectrum sound output. Volume can be controlled from the rear of the unit.

Prices: ZX81 model £12.00, Spectrum model £14.95 inc. VAT.

Abacus Electronics, 186 St. Helens Avenue, Swansea, W. Glamorgan.

Keyboard with Electronics for ZX81

A full-size, full-travel 43-key keyboard that's simple to add to your ZX81 and requires no soldering in the ZX81.

Complete with the electronics to make "Shift Lock", "Function", and "Graphics 2" single key selections making entry far easier.

Powered from ZX81's own standard power supply – with special adaptor supplied.

Two-colour print for key caps.

Amazing low price for complete build-it-yourself kit, only **£19.95** incl. VAT and carriage. Order As LW72P

Full details in the June 1982 issue of "Electronics – The Maplin Magazine" on sale at all good newsagents price 60p. In case of difficulty send 60p to address below, or £2.40 for annual subscription (4 issues).

MAPLIN Electronic Supplies Ltd

P.O. Box 3, Rayleigh, Essex SS6 8LR. Tel (0702) 552911

Retail shops at
159 King St., Hammersmith, London W6. Tel: 01-748 0926
284 London Rd., Westcliff-on-Sea, Essex. Tel: (0702) 554000
Lynton Square, Perry Barr, Birmingham. Tel: (021) 356 7292
(Shops closed Mondays). All mail to Rayleigh address.

MOTHERBOARD INPUT-OUTPUT PORT

Redditch Electronics manufacture several interesting add-on modules for the ZX81 computer. Their RE79 Input-Output port in its motherboard version is a most useful addition allowing you to control, using suitable interfaces, a wide range of devices such as printers, plotters, motors and lights. Inputs can be received through the input port from sensors or other computers.

A programmable m.o.s. input-output chip is used to keep power requirements low. The Input-Output port is memory mapped allowing it to be controlled using ZX81 BASIC, rather than machine code, with PEEK and POKE commands. Programming details are supplied along with examples. The port is available in kit form at £13.50 and built at £14.95.

The company also supply a range of motherboards to allow memory packs and up to two other cards to be fitted to the computer. One version is fitted with a voltage regulator to supply +5V to any cards plugged into the motherboard, cutting down the load and heat dissipation of the already heavily loaded ZX81 regulator and heatsink.

A version of the RE79 port is available with a male-female connector so that a motherboard is not required.

Redditch also make a 40 key keyboard which is a straight replacement for the ZX81 touch keyboard. The keys have the legends printed in red and black and protected by clear plastic keytops. This keyboard is supplied ready built at £20.00 or in easily built kit form at £17.00 inc. VAT and postage.

Many other useful items are also available from **Redditch Electronics, 21 Ferney Hill Avenue, Redditch, Worcestershire B97 4RU.**

1K MORSE TUTOR

P. J. HARRIS

ZX81
ZX80 +8K ROM

There have been many designs for dedicated Morse learning aids—indeed *Practical Wireless* has published several designs including a recent one which gave a visual read-out of the characters randomly generated. The ZX81 can be used to generate Morse characters either randomly (as is needed when trying to learn Morse Code) or as a direct translation of text. This program is a simple random character generator designed to run on the 1K unexpanded ZX81. The speed of sending the groups of five characters is set at 12 words per minute but this can be changed by POKEING different values taken from the table.

When the program is RUN the prompt "L/N/B" appears for Letters/Numbers/Both and the required selection is made by keying the appropriate button. There will be a short pause before the ZX81 starts sending groups of five random characters at 12 w.p.m.

The output is via the tape recorder lead and should be monitored via a low power audio amplifier or recorded directly onto tape.

At the end of the period the characters sent are displayed on the screen to allow you to check how well you have performed.

The program can be stopped by pressing any key and holding it down until the next character is started. Once the program has been completed it must be RUN again for the next batch of random characters.

Speed	POKE 16718,	POKE 16719,
2	45	78
4	18	78
6	10	78
8	6	78
10	4	78
12	2	78
Over 12	2	936 ÷ speed

```
   1 REM 8DIN5XPI??????????????
?                                
                                 
                                 
                                 
```

VIDEO OUTPUT FROM A ZX81

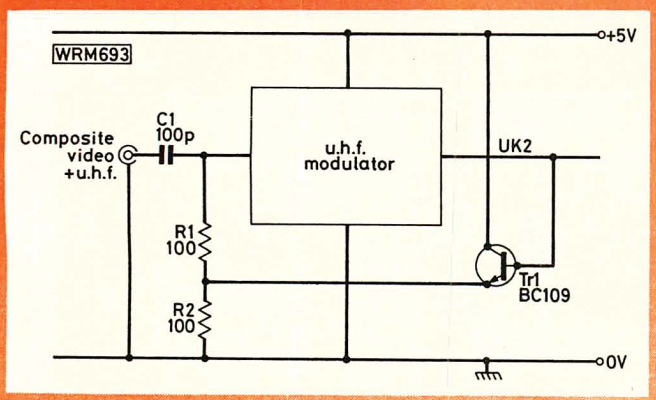
N. FOOT G8MCQ

Many amateurs will want to use the ZX81 with a monitor rather than a small portable black and white TV. Better picture quality is one reason for this and it also releases the portable TV set for domestic use.

As standard the ZX81 does not have a video output although the u.h.f. modulator is fed with video from the computer itself.

There are two alternatives, the first of which is to do away with the modulator altogether and just have the video signal output from the socket. This means that the computer can only be used with a monitor. This is no disadvantage if the computer is to be equipped with a new keyboard and built into a complete system, but it is a drawback if you still want to be able to use it, occasionally, with a TV away from the shack.

The circuit shown enables the video signal (buffered by an emitter follower) to be superimposed on the u.h.f. TV signal from the modulator output.



The video signal is fed from the p.c.b. into the modulator by a short length of tinned copper wire, entering the modulator through one of the holes in the plastics grommet. This wire must be carefully unsoldered from the plated-through hole in the p.c.b., making sure that the pad is not lifted, and bent so that it is horizontal and in line with the grommet hole.

Remove the lid of the modulator (it is a push-fit) and locate the centre tag of the output coaxial socket. The only connection to this tag is a small resistor mounted vertically inside the modulator and covered with a plastics sleeve. Unsolder this resistor from the tag and carefully bend it away from the tag. Push the body of a 100Ω resistor (R1) through the other grommet hole and cut the lead inside the modulator so that it can be soldered to the tag. Solder a small 100pF ceramic capacitor (C1) between the tag and the unconnected lead of the vertical resistor, making sure that the resistor does not touch anything else in the modulator.

Take the BC109 transistor (Tr1) and bend the emitter and collector leads at right angles to the base lead. Solder the base lead into the plated-through hole vacated by the input wire to the modulator, and then solder the collector lead to the +5V wire which runs between the p.c.b. and the feed-through capacitor in the top corner of the modulator body. Then solder the emitter lead to the free end of R1. The other 100Ω resistor (R2) is soldered between the emitter–R1 junction and the body of the modulator at the feed-through capacitor. Check all your work carefully and replace the modulator lid.

The signal coming out of the TV socket of the ZX81 should still drive a standard u.h.f. TV with no noticeable change in picture quality. It should also drive a standard monitor set.

Note that this modification will almost certainly invalidate the guarantee and if this worries you then leave the mod until the guarantee runs out.

If you wish to get rid of the modulator altogether then it is still advisable to build the emitter follower circuit to buffer the computer output.

COLOUR TEST PATTERNS

N. FOOT G8MCQ

16K ZX SPECTRUM

A useful program for the amateur who is interested in ATV is one for generating a test pattern both for use in the shack, checking out equipment, as well as for transmitting to other stations.

This program generates colour test patterns ranging from a solid colour raster in RED, GREEN, BLUE or WHITE, to a cross-hatch and a colour bar pattern. A circle generator is also incorporated into the cross-hatch generator.

To be able to transmit the test patterns you will need to be able to output the video signal directly to the ATV transmitter. This can be done by using the modification described for the ZX81, as the modulator is the same for both the 81 and the Spectrum. Video is also available at pin 15 bottom on the Spectrum edge connector.

```
  10 REM TV TEST PROGRAM
  20 REM FOR SINCLAIR SPECTRUM
  30 REM BY NICK FOOT  G8MCQ
  40 PAPER 0: BORDER 0: INK 7: C
LS
  50 PRINT "1) Red Raster"
  60 PRINT "2) Green Raster"
  70 PRINT "3) Blue Raster"
  75 PRINT "4) White Raster"
  80 PRINT "5) Cross Hatch"
  90 PRINT "6) Colour Bars"
 100 PRINT
 110 PRINT
 120 PRINT "Input Number Of Requ
ired Routine"
 130 IF INKEY$="" THEN GO TO 130
 140 IF INKEY$="1" THEN GO TO 20
0
 150 IF INKEY$="2" THEN GO TO 25
0
 155 IF INKEY$="3" THEN GO TO 30
0
 160 IF INKEY$="4" THEN GO TO 33
0
 170 IF INKEY$="5" THEN GO TO 35
0
 180 IF INKEY$="6" THEN GO TO 50
0
 190 GO TO 130
 200 REM RED RASTER
 210 BORDER 2: PAPER 2: CLS : PA
USE 0: GO TO 40
 250 REM GREEN RASTER
 260 BORDER 4: PAPER 4: CLS : PA
USE 0: GO TO 40
 300 REM BLUE RASTER
 310 BORDER 1: PAPER 1: CLS : PA
USE 0: GO TO 40
 330 REM WHITE RASTER
 340 BORDER 7: PAPER 7: CLS : PA
USE 0: GO TO 40
 350 REM CROSS HATCH
 355 CLS
 360 FOR n=8 TO 176 STEP 20
 370 PLOT 8,n
 380 DRAW 240,0
 390 NEXT n
 400 FOR n=8 TO 255 STEP 20
 410 PLOT n,8
 420 DRAW 0,160
 430 NEXT n
 440 CIRCLE 256/2,176/2,75
 450 PAUSE 0: GO TO 40
 500 REM COLOUR BARS
 510 CLS
 520 FOR i=0 TO 21
 530 FOR n=1 TO 7
 540 PRINT INK n;"████";
 550 NEXT n
 555 PRINT
 560 NEXT i
 570 PAUSE 0: GO TO 40
```