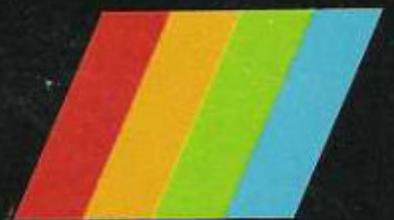


sinclair

# ZX Spectrum 128

Introduction





# INTRODUCING THE SPECTRUM 128

Your Spectrum 128 is two computers in one.

It has all the features which have made the Sinclair Spectrum the most popular home computer you can buy, and will run existing software for the ZX Spectrum+ and the 16 and 48K Spectrum.

But now the Spectrum 128 adds a whole new dimension to Spectrum computing. Its full 128K of memory means that it can run more complicated programs, play more exciting games, store more information – everything you want to do will run that much more easily or work that much better.

The Spectrum 128 also has many convenient features in addition to those on the standard ZX Spectrum+. These include advanced sound, including the ability to drive a synthesizer; a full screen editor to make it easier to write your own programs in BASIC; and a Calculator facility. There are also extra sockets for connecting peripherals such as a colour monitor or a printer and a special extension keypad giving easy control of the editing facilities.

A simple command lets you switch off the features which are unique to the Spectrum 128 so that it performs exactly like a standard 48K Spectrum+ (if you want to run a 48K Spectrum game, for instance).

Your Spectrum 128 has two manuals. This introduction describes in detail how to set up your Spectrum 128 and how to use its special features. There is also a copy of the ZX Spectrum+ User Guide, which describes how the Spectrum 128 works when running as a Spectrum+, and has detailed instructions on how to write your own BASIC programs.

Start by reading the first section of this introduction (pages 2 to 6) which shows how to set up your Spectrum 128, how to load 128K programs, and how to use the computer as a Spectrum+.

The second part of this introduction covers the special programming features of the Spectrum 128, including how to write or edit a BASIC program, how to use the Calculator and how to program music. If you want to learn programming on the Spectrum 128, we suggest you start by trying some of the examples in the ZX Spectrum+ User Guide.

## SETTING UP

When you unpack your Spectrum 128, make sure that you have all the parts shown on page 4 of the ZX Spectrum+ User Guide. (Note that the software supplied is different from that detailed there). You will also need your own colour TV or colour monitor, although you can use a black and white TV if you want. You will also need a cassette player if you want to load any cassette-based software.

### Connecting up your Spectrum 128

All connections to the Spectrum 128 must be made firmly – especially the power supply. If you accidentally switch off the power or disconnect the power lead while the Spectrum 128 is running, you will lose the program and any information which is in the computer.

You must be careful how you plug or unplug the connectors for some of the equipment which can be connected to the Spectrum 128. Like any computer, the Spectrum 128 can be damaged if some of its leads are carelessly plugged in or disconnected when the computer is switched on. This applies especially to any equipment which plugs into the edge connector on the back – such as a joystick, for example. **Never** make or break any connection to the edge connector (or to an extension of it on a 'through' peripheral) without first turning off the Spectrum 128's power supply by pulling out the plug from the back of the computer. If you do not, you may damage either the Spectrum 128, or what you are connecting it to, or both.

Your TV or monitor is a powerful generator of static electricity for a few seconds after it is switched on or off. If you connect or disconnect it from the Spectrum 128 during this period, you could end up giving your computer a fatal static shock – so leave the connections alone for a few seconds after switching the TV or monitor on or off.

The other connectors on your Spectrum 128 can be connected or disconnected with the computer power on, but take care with any other mains powered devices (cassette recorder, printer etc) since they can generate voltage surges at switch-on

which might cause the computer to crash. Switch them on before connecting them to the Spectrum 128.

### The Spectrum 128 power supply

The mains connection to your Spectrum 128 is the same as described on page 5 of the ZX Spectrum+ User Guide. When you have finished using your Spectrum 128, always switch off the power and pull out the mains plug.

### Connecting a TV

If you are using the Spectrum 128 with a colour or black and white TV, you connect it exactly as described on pages 6 and 7 of the ZX Spectrum+ User Guide.

Unlike the Spectrum+ which has an internal loudspeaker, the Spectrum 128's sound is directed through the TV, so you can control the sound level by turning the TV's volume control up or down.

The Spectrum 128 has a built-in TV test screen to ensure that you get the best possible picture and sound. You turn it on by holding down the [BREAK] key and pressing the reset button or switching on the power. When your TV is tuned correctly, you will see a multi-coloured pattern and hear an intermittent tone. If there is an AFC switch, turn this off, then tune the TV until you see coloured bars and numbers and hear a sound. Make sure that you do not tune in just the picture – the sound should be present as well. Reset the AFC, then adjust volume and picture controls as you prefer.

### Connecting a monitor

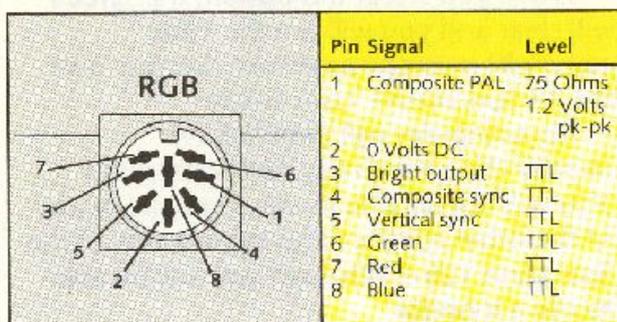
The Spectrum 128 has an output suitable for use with RGB or colour composite monitors, which give a better quality colour picture than a TV. Sinclair Research will offer advice on suitable models.

Because most monitors do not have sound, you may need to amplify the Spectrum 128's sound output separately (see page 3 for details).

The monitor lead plugs into the Spectrum 128's RGB socket. There is no need to tune in the monitor, although some types will need setting to match the Spectrum 128's signal.

A lead ready to connect to the RGB socket is available from Sinclair Research. You will need to make your own connections at the monitor end, since there

is no standard connection. The diagram below gives details of the pin configuration of the Spectrum 128's RGB output. The monitor dealer should be able to advise you how to make the connections to the monitor.



### Connecting an extension keypad

The Spectrum 128 has an optional extra extension keypad which provides extra facilities when editing programs and works as a games controller and calculator.

The keypad is connected by its own coiled cable which fits into the socket on the front of the computer. There is a slight pause after you first switch on the Spectrum 128 during which the keypad will not respond. Note that the keypad functions are not available when running 48 BASIC or playing a 48K game, and so the keypad need not be connected. It can safely be unplugged while the computer is switched on.

### Connecting a cassette recorder

A cassette tape recorder can be connected to the Spectrum 128 for loading or saving programs in a similar way to that described on pages 12 and 13 of the ZX Spectrum+ User Guide.

Note that the MIC and EAR sockets are on the left of the computer rather than at the back, and that the double lead can be used **either** to connect the EAR socket on the Spectrum 128 to the EAR socket on the cassette player (for loading) **or** MIC to MIC (for saving) – you should not connect both at the same time. You can plug or unplug the lead while the computer is switched on.

You can also use a cassette player as an external amplifier, as shown on page 37 of the ZX Spectrum+ User Guide.

### Connecting Microdrives

Sinclair Microdrives are a powerful means for saving and loading programs more

quickly than using tapes. They are connected to the Spectrum 128 by using a Sinclair Interface 1, as described on pages 46 and 47 of the ZX Spectrum+ User Guide.

### Connecting a joystick

A joystick can be connected to the edge connector on the back of the Spectrum 128 by using a suitable interface which should be available with the joystick. Make sure that the model you buy will work with your software, as there are several joystick standards. Do not connect or disconnect a joystick interface while the Spectrum 128 is switched on.

### Connecting a printer

The Spectrum 128 can be used with many types of printer which conform to the RS232 standard (the commonest type) or which are fitted with an RS232 interface. A separate list of suitable models can be obtained from Sinclair Research.

The printer plugs into the RS232 socket on the left hand side of the Spectrum 128, using a special connecting lead which can be obtained from Sinclair Research.

Printers such as the Sinclair ZX printer which were designed for earlier Spectrum models can also be used with the Spectrum 128 but will only work when the computer is running 48 BASIC. They are not suitable for use when the Spectrum 128's special features are in use. This type of printer plugs onto the edge connector at the back of the computer.

### Connecting musical instruments

The Spectrum 128 can be used to control electronic musical instruments such as synthesizers and drum machines which conform to the MIDI standard (see page 14).

To make the connection, you need a MIDI lead which is available from Sinclair Research.

### Connecting other peripherals

Your Spectrum 128 can be connected to a wide variety of other computer peripherals such as light pens, disk drives and modems. Make sure that the equipment is specifically compatible with the Spectrum 128 as well as other Spectrum models. Connection details should be provided by the manufacturers of the equipment.

# GETTING STARTED

When you switch on your Spectrum 128 or press the reset button on the left hand end, you will see the Spectrum 128 main menu screen which lists these main functions and allows you to choose between them with a few simple keypresses

Tape Loader  
128 BASIC  
Calculator  
48 BASIC  
Tape Tester

There is a blue bar (the selection cursor) showing the option which is currently selected – it starts off on Tape Loader at the top of the menu. Use the [↑] and [↓] keys on the main keyboard or keypad to move the selection cursor up and down. Press [ENTER] (or [CMND] if you have a keypad) to select the option shown by the cursor.

## Tape Loader

This enables you to load any 128K program from tape at high speed. Taped 48K or 16K programs must be loaded by selecting 48 BASIC. The Tape Loader is described in detail on page 5.

## 128 BASIC

Select this option to write your own 128 BASIC program. 128 BASIC is similar to standard Spectrum BASIC, with the addition of some new commands and improved editing. Spectrum BASIC is described in the ZX Spectrum+ User Guide, and pages 6–8 of this Introduction give full details of the extra features.

## Calculator

This option turns the keyboard or keypad into a simple calculator. The calculation and results are displayed on the screen. Page 8 of this Introduction shows you how to use the Calculator.

## 48 BASIC

Select this to make your Spectrum 128 work as a Spectrum+, allowing you to load 48K or 16K Spectrum programs or write your own programs in Spectrum BASIC.

When you select this option, the screen will clear and you will see the 1982 copyright message as shown on page 6 of the ZX Spectrum+ User Guide.

The computer will then behave exactly like an ordinary 48K Spectrum+. You will not be able to use a keypad or any of the other special program features of the Spectrum 128 – although you will be able to use a monitor.

If there is a program in your Spectrum 128's memory when you select 48 BASIC, it will be lost. It is possible to carry over a program from 128 BASIC to 48 BASIC by typing the command **SPECTRUM**. However, any commands (such as sound commands) which are only available in 128 BASIC will not be accepted by the computer.

Your Spectrum 128 will stay in 48 BASIC until you switch off or press the reset button. There is no command which will let you return to 128 BASIC – you must press the reset button and start again.

## Tape Tester

This will check that you have set the volume on your cassette player to the best possible level for any given tape. Details are given in the Loading a program section.

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# LOADING A PROGRAM

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The Spectrum 128 can be used to run programs which you have bought for it, or programs which you have written yourself and saved on tape, Microdrive or disk. It will load all programs which were specially written for the Spectrum 128, as well as many programs which were written for the Spectrum+, Spectrum 48K and 16K. However, you must use a different loading method for these programs, and it is extremely unlikely that a program will run if you use the wrong method.

Loading problems can be minimised by running the special Tape Tester program to ensure that the tape player is set to the ideal volume.

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## Loading checklist

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The different loading methods are explained in detail below. This checklist shows when to use each one.

### ■ 128K programs on tape

Most programs will load automatically by using the Tape Loader option. A very few may need special loading instructions entered in 128 BASIC.

### ■ 128K programs on Microdrive or disk

The loading instructions must be entered from 128 BASIC.

### ■ Spectrum+, 48K or 16K programs on tape, Microdrive, or disk

The loading instructions must be entered from 48 BASIC.

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## Loading a 128K program

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The Tape Loader option on the main menu can be used for any cassette-based 128K program which accepts a **LOAD** command (almost all commercial programs do this). It cannot be used for Microdrive-based or disk-based software, nor the very small number of taped programs which require special loading instructions.

To use the Tape Loader, ensure that your cassette player is connected correctly (see page 3), then select the Tape Loader option on the main menu. If this is the first time you have used the program with your

Spectrum 128, you may wish to use the Tape Tester option first (see below). Otherwise, just press **PLAY** on your cassette player and loading is then automatic.

If the program is on Microdrive or disk, or the cassette is one of the very few which requires a special loading command, you will need to select 128 BASIC from the main menu. Now check the loading instructions given with the software and type in the command given there (see 128 BASIC for further details).

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## Loading a 48 or 16K program

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Select 48 BASIC then follow the software loading instructions given in the ZX Spectrum+ User Guide.

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## Loading problems?

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Most tape loading problems are not due to a fault with the software or the computer. If you have problems loading a program from tape, first check that you have used the right method. Have you tried to load a 128K program in 48K BASIC, or vice versa?

Then check that your cassette player is set to the optimum volume (see below). You may also find it useful to check the Software loading troubleshooter chart on page 16 of the ZX Spectrum+ User Guide.

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## Using the Tape Tester

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The Tape Tester provides a means of checking that your cassette player is set to the best volume for any given tape. This will minimise loading problems, but if your cassette player is faulty or you have a badly recorded tape, it does not guarantee loading.

Connect up your cassette player and insert the program tape which you wish to test. Wind it on a little so that you have a signal on the tape. Now select Tape Tester from the menu. You will see a horizontal blue bar on the screen with a light blue square to the left of it. Start the tape and you should see the light blue square move to the right.

Now adjust the volume control up or down until the light blue square falls as far to the right as possible.

Leave the volume control in this position and rewind the tape. You can now load it as normal. It is worth marking the volume setting on the tape label for future reference.

## 128 BASIC

Choosing the 128 BASIC option from the main menu lets you write your own BASIC program. It also lets you edit a program which you have previously written, or issue a direct command for things like loading software which cannot be loaded using the easy Tape Loader.

If you are used to writing in Spectrum BASIC (see the ZX Spectrum+ User Guide), you will find that 128 BASIC is very similar but contains some extra commands. The most important difference is the way in which you type in 128 BASIC.

Ordinary Spectrum BASIC commands are entered in by pressing one key (sometimes after pressing one or two others). The whole keyword (printed in small letters on the key) then appears on the screen.

In 128 BASIC none of these special key entries apply. Instead, you type each word in full, letter by letter.

You can use 128 BASIC to type in any program which was originally written for the Spectrum 128. It can also be used for many programs which were written for the 16K or 48K Spectrum, including those in the ZX Spectrum+ User Guide. It does not matter that these originally used special keys to enter them. However, you may find that some programs for the earlier Spectrums contain instructions which will cause them to fail if run in 128 BASIC.

Note that the TRUE VIDEO and INVERSE VIDEO keys are not used in 128 BASIC. INVERSE effects are available by using the keywords INVERSE 1 and INVERSE 0 as described on page 31 of the ZX Spectrum+ User Guide.

In 128 BASIC, EXTEND MODE is only used for a few symbols shown above the letters on the keys, such as  $\uparrow$ . To get these symbols, press the EXTEND MODE key and then SYMBOL SHIFT and the symbol key together. The Spectrum 128 then reverts to normal typing.  $\geq$ ,  $\leq$  and  $\langle \rangle$  must be entered as two characters. GRAPHICS mode works as it does in Spectrum BASIC but you must leave GRAPHICS mode if you wish to use the cursor keys to edit a program. Colour control codes (see page 33 of the ZX Spectrum+ User Guide) are not available in 128 BASIC and you should use

the colour keywords instead. Spectrum BASIC programs which contain the keywords POKE or PEEK may not work correctly in 128 BASIC.

When you are typing in 128 BASIC, you can use either capitals or lower case letters except when entering music (see page 10). The other examples printed here are in capitals for clarity, but this is not essential. You also do not always need to include spaces on either side of BASIC keywords as shown in the program examples (the Spectrum+ puts these in automatically). However, if you are typing a keyword next to another letter (eg, FOR N or IF A) you must put in the space. When a program line is accepted by the Spectrum 128 (see below) it automatically converts all the keywords to capitals and inserts spaces as shown in the examples.

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### Start typing

---

As soon as you have selected 128 BASIC from the main menu, you will see a blank screen ready to type onto. Try typing this

---

```
10 BORDER 1:PAPER 6:INK 2:CLS
```

---

Note that you could just as well type

---

```
10 border 1:paper 6:ink 2:cls
```

---

as they mean the same to the Spectrum 128. Press [ENTER] when you reach the end of the line.

Now you want to run your program to see its effect. Type

---

```
RUN
```

---

and press [ENTER]. The screen should turn yellow with a dark blue border.

---

### Program errors?

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The Spectrum 128 will check each program line after you have typed it in. If you make a typing mistake which it cannot understand, it will not accept the line when you press [ENTER]. The commonest errors are spelling mistakes and missing spaces. For example, in the program line you have just entered, you might have typed

---

```
10 BORDER 1:PAPER 6:UNK 2:CLS
```

---

which has a spelling mistake.

When an error is detected, a red cursor will flash in the line. This cursor will almost always indicate the keyword which

contains the first error (as it will here), but with some types of mistake this is not the case.

The Spectrum 128 only checks each line as you enter it, so it does not guarantee that the program as a whole is correct. Nor is it a mind-reader. If you type

---

```
10 PRINT "Hello"
```

---

the line will be accepted. The computer cannot know that you meant to type "Hello".

---

### Correcting your program

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If you make any typing mistakes or just want to change something, the BASIC editor lets you make corrections very easily using the keyboard. And if you have a keypad, this has extra keys which give you more control over moving around and deleting parts of the program.

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### Moving around

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Try moving the cursor around the program using the cursor keys on the keyboard

- [→] moves the cursor one character to the right
- [←] moves the cursor one character to the left
- [↑] moves the cursor up one line
- [↓] moves the cursor down one line

If you have a keypad, these movements are duplicated by the red cursor keys. You also have these additional keys

- [⇐] moves the cursor as far as the beginning of the next word
- [⇐] moves the cursor as far as the next space to the left
- [↑↑] moves the cursor up 10 lines of the program – this will not work unless you have more than 10 lines in your current program
- [↓↓] moves the cursor down 10 lines of the program – this will not work unless you have more than 10 lines in your current program
- [⇐] moves the cursor to the start of the BASIC line
- [⇒] moves the cursor to the end of the BASIC line

---

### Deleting program entries

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You can erase mistakes by using the [DELETE] key on the keyboard to delete the character to the left of the cursor.

If you have a keypad, this offers several extra delete keys.

[<sup>DEL</sup>] deletes the character to the left of the cursor

[<sup>DEL</sup>] deletes the character which the cursor is on

You can delete larger amounts by using the following keys on the keypad. To prevent unwanted erasures you must hold down [SHIFT] at the same time as pressing these keys.

[<sup>DEL</sup>] deletes as far as the next space to the left of the cursor

[<sup>DEL</sup>] deletes from the character under the cursor, as far as the next space to the right

[<sup>DEL</sup>] deletes from the left of the cursor to the beginning of the line

[<sup>DEL</sup>] deletes from the character under the cursor to the end of the line

---

### The 128 BASIC commands

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Press [EDIT] (or [CMND] if you have a keypad) to bring up the Options menu which offers these commands.

128 BASIC  
Renumber  
Screen  
Print  
Exit

This works like the main menu – you move the cursor up and down with [↑] and [↓], and use [ENTER] to select your option.

---

### 128 BASIC

---

Selecting this returns you to the BASIC screen if you have selected the command Options menu by mistake.

---

### Renumber

---

This automatically alters the line numbers of the current BASIC program so that it starts at line 10 and goes up in steps of 10. It also changes any references to the line numbers which appear within the lines (such as GOTO 200, for example). This is most useful when you have developed a program by adding new BASIC lines between the originals. You can use the command to tidy up the program by spacing it out to absorb the new additions.

---

### Screen

---

This option changes the size of the BASIC program screen. Instead of your program occupying the whole screen area, it can be displayed in just the bottom two lines. The

small screen is mainly used when you are saving a screen display or copying it to a printer – confining the program to an off-screen area ensures that it does not overwrite the display which you want to keep.

### Print

If you have a suitable printer connected, this lets you print out the current program on paper.

If no printer is connected, or there is some other problem, the computer may appear to 'freeze'. It can be cleared by pressing [BREAK]. When printing is complete, you will be returned to the program screen.

### Exit

This option returns you to the main menu. Your current program is automatically stored and will be recalled if you select 128 BASIC again. If you switch off, select 48 BASIC or press the reset button the program will be lost.

## USING THE CALCULATOR

The number keys and mathematical symbols on the keyboard or keypad can be used exactly like an ordinary pocket calculator, by selecting the Calculator option from the main menu.

When you select the option, you will see the blank Calculator screen. Now just type in your calculation in standard mathematical notation. For example, type

---

27\*45

---

When you press [ENTER] the answer = 1215 will appear. As on an ordinary calculator, the current result is held in the Spectrum's memory – so if you want to carry out further calculations, there is no need to retype it. For example, to take 685 from the answer you just got, you type

---

-685

---

and press [ENTER] to see the answer = 530.

The calculator uses all the mathematical functions available in Spectrum BASIC (see the ZX Spectrum+ User Guide). The keypad has the four main mathematical functions \* / + - and also supports the use of brackets.

When you have finished with the calculator, you can return to the main menu by pressing [EDIT]. This brings up the Options menu:

Calculator  
Exit

Select Calculator to return to the Calculator screen, or Exit to return to the main menu.

# STORING DATA IN MEMORY

The additional memory in your Spectrum 128 can be used for running large machine code programs. It can also be used by BASIC to store programs and data in much the same way as a cassette or Microdrive – but many times faster.

This type of storage is called a RAM disk and it allows BASIC programs to manipulate data in much the same way as professional programs on big machines.

An important difference between RAM storage and a cassette or Microdrive is that the data will be lost as soon as the power is switched off or the reset button is pressed. It will also be as good as lost if you type **SPECTRUM**. Always save your work to cassette or Microdrive before doing any of these things. Data which has been stored in RAM will not be affected by a **NEW** command.

All the commands for RAM disk storage are the same as cassette commands except that an exclamation mark (!) must be typed after the keyword, eg

- SAVE! "program" LINE 10
- LOAD! "program"
- SAVE! "picture" SCREENS
- LOAD! "physics" DATA p()
- MERGE! "overlay"

The **VERIFY** keyword is not used with the RAM disk.

You can get an alphabetic catalogue of all the files (programs and data) saved in RAM by typing

## CAT!

Individual files can be removed by typing

## ERASE! "filename"

# MUSIC AND SOUND

The Spectrum 128 has two different ways to make music and sound effects. Both work through the sound channel of your TV or can be sent to an external amplifier as explained on page 3. There is no internal speaker.

The first method uses the Spectrum BASIC **BEEP** command (see pages 36–37 and 53 of the ZX Spectrum User Guide). But 128 BASIC also has the **PLAY** command which allows you to make sophisticated music with up to three notes at once. It also gives you more control over the sound of each individual note than is possible using **BEEP**.

The **PLAY** command can be used to let your Spectrum 128 play tunes on many types of synthesizer and other electronic musical instruments, such as drum machines. The Spectrum 128 is MIDI (Musical Instrument Digital Interface) compatible, which allows it to be connected to any other equipment which conforms to the MIDI standard.

## Programming sounds

Making music and sound effects with **PLAY** is simple. You just type in the series of notes that make up a tune, then ask the Spectrum 128 to **PLAY** them. You can also include instructions that tell the Spectrum 128 what sort of tone you want for the sound.

To hear some of the wide range of sounds that you can make, type in one of the two programs below, **RUN** it, then try the other example. Don't worry if the program lines look complicated, they are explained in detail later

## MUSIC

```

10 LET a$="T18006(CDEC)(5EF7G)
   (3GAGF5EC)5Cg7C9CgC"
20 LET b$="04(CDEC)(5EF7G)(3GA
   GF5EC)5E17E9EbE"
30 LET c$="03(7CG)(7CG)(7CG)5G
   D7G9GDG"
40 PLAY a$,b$,c$

```

## SOUND EFFECTS

```

10 LET a$="M8UX350W5D7(((C)))"
   : PLAY a$ : PAUSE 25

20 LET a$="M56UX5000W103(((C)))"
   : PLAY a$ : PAUSE 25

30 LET a$="M5EW201N8C" : PLAY a$
   : PAUSE 25

```

### Using the PLAY command

In the examples above, you will see that each time the **PLAY** command appears, it is followed by up to three different letters, each followed by a \$ sign in a statement like

**PLAY a\$,b\$,c\$**

Each of these is the name of a *string* (a series of characters) which you have already given to the computer earlier in the program. The strings tell the Spectrum 128 which sounds to make.

**PLAY** controls three separate sound channels called A, B, and C and there can be up to three strings, one for each channel. In the MUSIC example given above, a\$ tells channel A to play the melody line, b\$ tells channel B to play a harmony, and c\$ tells channel C to play a bass part. In the SOUND EFFECTS example, only one noise is used at a time (although up to three can be), so each one is in channel A and the command is simply **PLAY a\$**.

In fact any of the channels can produce either a musical tone or noise, so you can mix sound effects in with your music (see Channel selection).

### Constructing strings

Composing music and sound effects on the Spectrum 128 is simply a matter of creating strings containing the information you want. You can see how this works in the MUSIC example above. Each string is created with the **LET** command, followed by the name of the string, and its contents enclosed in "" marks. Try this example, which plays just one note – an A.

**LET a\$="a":PLAY a\$**

Any music program using **PLAY** also uses **LET** to tell it what to play, as you can see by

looking at the earlier examples. The reason why these programs look more complicated than the example above is that the strings enclosed in the "" marks contain many letters and numbers to define a longer tune or more complex sound.

Any musical sound has a pitch and duration. It also has a volume and tone quality. The strings in the earlier examples contain information about all of these. The summary below lists each possible command, and they are explained in detail opposite.

### PLAY command summary

This is a brief list of the commands which can be contained in a **PLAY** string. Note that all letters except note names must always be in capitals.

String entry	Function
c-b or C-B	Gives pitch of note within current octave range
\$	Flattens note following it
#	Sharpens note following it
O	Followed by number 0 to 8 sets current octave range
1-12	Sets length of notes
&	Denotes a rest
N	Separates two numbers
V	Followed by a number 0 to 15 sets volume of notes
W	Followed by a number 0 to 7 sets volume effect
U	Turns on volume effect in any string
X	Followed by a number 0 to 65535 sets duration of volume effect
T	Followed by a number from 60 to 240 sets tempo of music
( )	Enclose repeated phrase
!!	Enclose a comment
H	Stops a <b>PLAY</b> command
M	Followed by a number from 1 to 63 selects channels
Y	Followed by a number from 1 to 16 turns on a MIDI channel
Z	Followed by a number sends that number as a MIDI programming code

### Setting the pitch

As you saw above, you set the pitch of any note by giving its musical name – eg, C E G. Sharp notes are prefixed by # (eg #C) and flat notes by \$. Your 'instrument' covers two octaves in the key of C, and uses letters c to b for the notes in the lower octave, C to B in capitals for the higher one.

Any number of notes within these two octaves can be played one after another, eg

```
10 LET a$="cfedafgCFEDAFGCC"
20 PLAY a$
```

If you want to span more than just two octaves, you can change the overall pitch of your 'instrument' by using the octave command O followed by a number from 0 to 8. If you do not specify an octave (as in the example above) it is automatically set to 5 (the range containing middle C). The octave command remains in force for all notes which follow it until a new octave command is given.

This program lets you hear the same tune played in a higher octave (just add the O7 to your earlier program)

```
10 LET a$="O7cfedafgCFEDAFGCC"
20 PLAY a$
```

Try changing the octave number progressively to hear the full pitch range which your Spectrum 128 can produce. Notice that some of the very lowest notes in octaves 0 and 1 will not be reproduced at the right pitch except through the MIDI output. The Spectrum 128 will simply play them at the lowest pitch possible.

Since each pitch range covers two octaves, two adjacent ranges overlap. For example, the high part of O4 contains the low part of O5 (see the diagram below). Note that you can extend any range slightly by using a series of sharps (####) or flats (\$\$\$\$) to raise the pitch of individual high notes or lower the pitch of low ones.

### Note duration

If you do not specify the length of each note, they will all be played at the same length (as crotchets) as in the examples above. You can fix the length of any note or series of notes by prefixing it with a number from 1 to 12. This program lets you hear the different note duration with numbers from 1 to 9.

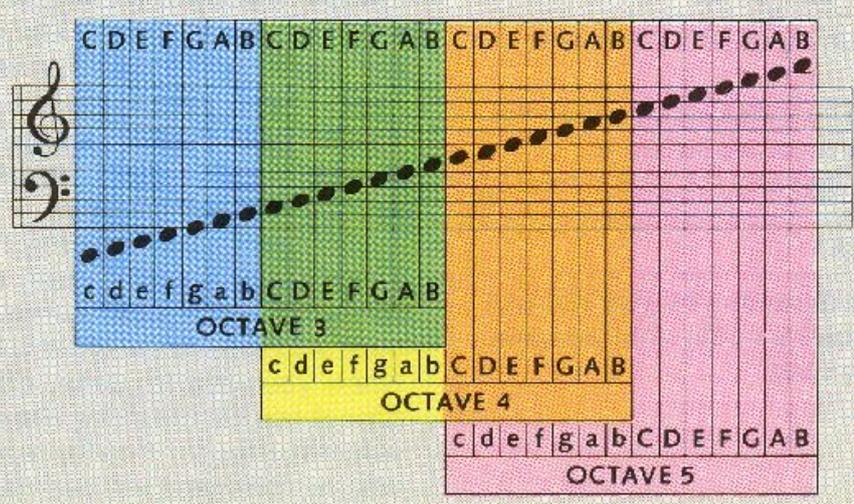
```
10 LET a$="1C2C3C4C5C6C7C8C9C"
20 PLAY a$
```

## Pitch values for making music with PLAY

This diagram shows how you can create different notes using the Spectrum 128's octave command. The command O followed by a number from 0 to 7 sets the Spectrum 128 to a range of two octaves beginning

with a C. The diagram shows the complete range of notes covered by O4, O5, and O6. Adjacent octave ranges overlap, so the same notes appear in the upper part of one range and the lower part of another.

Individual notes within an octave range are set by using the letters c to b in lower case for the lower notes and C to B in capitals to give the notes in the upper octave. Placing a # before any note letter gives a sharp note – a \$ flattens it.



1 is the shortest note and 9 the longest. They are related to musical convention according to the following table.

Number	Note Name	Musical symbol
1	semi-quaver	
2	dotted semi-quaver	
3	quaver	
4	dotted quaver	
5	crotchet	
6	dotted crotchet	
7	minim	
8	dotted minim	
9	semi-breve	

Each of these controls the length of all notes which follow it until you give a new number code.

You can also use the numbers from 10 to 12 to specify triplet notes (three notes played in the time normally used for two).

10	triplet semi-quaver	
11	triplet quaver	
12	triplet crotchet	

Each of these only applies to the three notes following it and must be followed by their three names, eg

```
10 LET a$="11ACE"
```

A rest (no note playing) is specified by a & and has the same length as the current note. For example

```
10 LET a$="7A&B&C&D&E"
```

is five minims with equal pauses between them.

Tied notes can be indicated by giving the two note durations connected by an underscore character and the note name, eg

```
10 LET a$="3_5A"
```

The second note duration you give will also apply to any following codes until you give another duration code.

## The N command

In some of the examples you will see the letter N used to introduce a series of notes within the string, eg

```
LET a$="O7N1CDE"
```

N is used in cases where two sets of numbers would otherwise clash. In the example above, O is set to octave 7, then a series of notes is given, starting with the duration code 1.

Without the N code, the Spectrum 128 would read the octave code as 71 – obviously not what was intended!

## Note volume

The overall volume of the sound is controlled by the volume setting of your TV or amplifier. You can control the volume of individual notes and phrases within the tune by using the V command. V followed by a number from 0 to 15 sets the following note(s) to a constant volume. The lower the number, the quieter the sound, with V0 completely silent (V0 is a useful way of stopping one channel playing while others continue). V15 is the maximum and is used automatically by the Spectrum 128 if you do not specify a level.

The low volumes are very quiet and you will normally use 10 to 15 unless you are outputting to an amplification system or via the MIDI port to a synthesizer. Try running this program

```
10 LET a$="V10cdefgabCDEFGAB"
20 PLAY a$
```

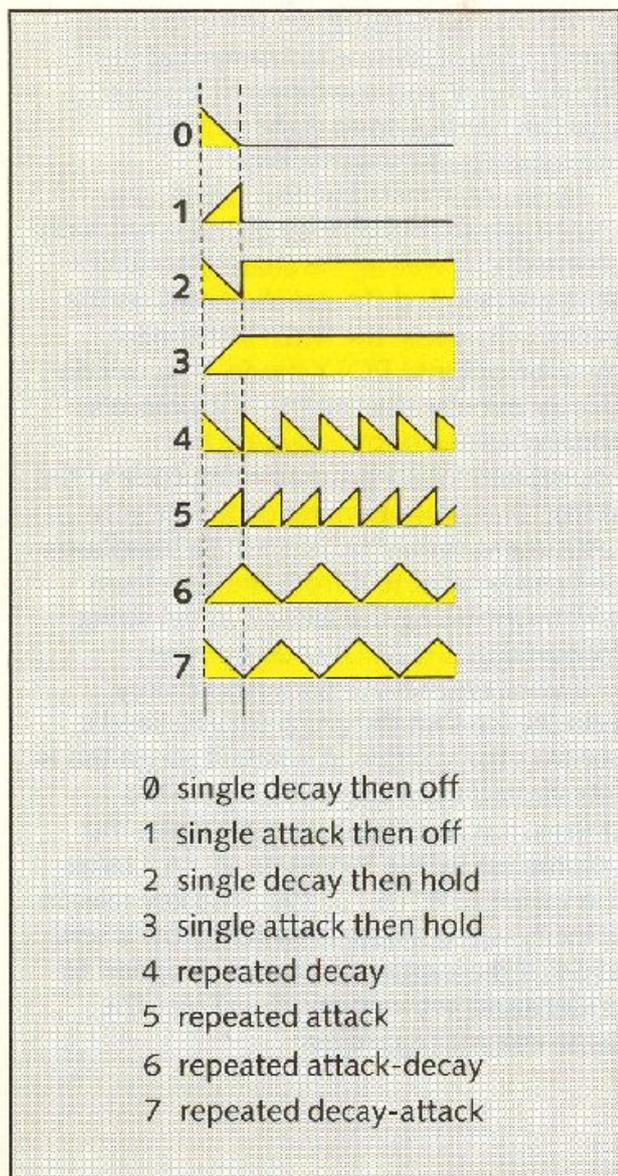
Now try changing the number after the V to a new value to hear the difference

## Volume effects

Instead of you just setting each note to a fixed volume, PLAY also lets you change the volume of the sound while it is playing. For example, you can make a note start suddenly and then die away (like a piano) or make a sound effect rise and fall in volume (like a steam train).

This effect is controlled by the letter W which can be included in any of the strings controlled by the PLAY command. You must also include the letter U in each string where you want to use the effect. You cannot use it if the string already has a volume setting (if it contains a V) – the volume command will overrule the effect.

The W must be followed by a number from 0 to 7 which controls how the sound builds up (the attack) or falls off (the decay). This is the full range of numbers and what they do



This program plays the same note with each effect in turn to let you hear what they sound like

```
10 LET a$="UX1000W0C&W1C&W2  
C&W3C&W4C&W5C&W6C&W7C"  
20 PLAY a$
```

Notice the U to turn on the effect, then the series of W numbers.

There is one other new command used here, the letter X. This can be followed by a number from 0 to 65535 to set the length of the sound effect – the larger the number, the longer the effect is drawn out.

You do not have to include an X setting. If you do not, the Spectrum 128 will automatically choose the longest. In

general, repetitive effects (W4 to 7) are more effective with quite short settings, eg X300. 'Single shot' effects (W0 to W3) need a longer period, eg X1000. Try changing the value after X in the program above to hear the difference.

### Tempo

The speed at which a piece of music is played can be set with the command T followed by the number of crotchet beats per minute (bpm) in the range 60 to 240. The command controls the speed at which all notes are played, but can only be included in channel A (the first string after the PLAY command) otherwise it is ignored, eg

```
10 LET a$="T180cdefg"  
20 PLAY a$
```

If no tempo is specified, the music will be played at 120 bpm.

### Repeated phrases

Any musical phrase can be repeated by enclosing the appropriate string or part of a string in brackets. For example

```
10 LET a$="abc(DEFG)"
```

will repeat the last four notes. If there is an unequal number of brackets, the phrase will be repeated back to the last bracket. If there is only a closing bracket, the phrase will be repeated back to the beginning of the string, eg

```
10 LET a$="abCDEFG)"
```

will repeat all seven notes. Double closing brackets

```
10 LET a$="O2CEGA))"
```

will cause an 'infinite' repeat. This is particularly useful for things like repetitive bass lines. To turn off an 'infinite' repeat you use the H command.

### The H command

An H included in any string immediately turns off the PLAY command. The main use of this is where you have an infinitely repeated bass line in one string. You can stop this at the end of the tune by putting an H on the end of the string which plays the melody.

## Comments

You can include reminders and comments anywhere you like by using !! marks. Anything written after a ! will be ignored until the next ! or the " at the end of the string is reached, eg

```
10 LET a$="abCDEFG!chorus!aCEaDG"
```

## Channel selection

The command M is used to select which of the three channels are in operation and whether these give noise or musical tones.

You can have a maximum of three channels in use at any one time, but it does not matter whether they are all tone, all noise, or a mixture of both.

Your choice is entered with a number following the M, worked out like this

	Tone channels			Noise channels		
	A	B	C	A	B	C
Number	1	2	4	8	16	32

Mark each channel you want to turn on, and note down its number. Then just add them together to get the code you should use after the M. For example, if you want to use tone channels A, B, and C, you add the numbers  $1+2+4=7$ , so you use the command M7. In the same way, M56 would turn on noise channels A, B, and C.

Noise can be used on any channel but the most wide-ranging frequencies are available in channel A. For the best results put your sound effects in the string which controls this channel – a\$, the first string after the **PLAY** command.

## Controlling musical instruments

Whenever **PLAY** is running, a signal can be sent to the MIDI port in the RS232 socket at the front of the computer. This output will drive any MIDI-compatible musical instrument such as many makes of synthesizer and drum machine, so that the instrument will play the music which has been programmed into the Spectrum 128.

Using the MIDI output lets you play more complicated music with up to eight notes at a time instead of three. All you do is to follow the **PLAY** command with the names of up to eight strings, (a\$ to h\$, for example) each of which is constructed as described above.

Do not try to send music to the MIDI port unless you have already connected the instrument (see page 3). To send the output to the MIDI port, each string should include the letter Y followed by a channel number from 1 to 16. If you use the same number in each string, up to eight notes can be played by one instrument at the same time. If you use different numbers, you can control up to eight different instruments at the same time.

Most MIDI instruments power up in OMNI mode so that they play the notes on channel 1 as well as the channel to which they are directed. To get the notes on the correct channels, the MIDI instrument must be put into POLY mode. You can do this by directly altering the instrument's MIDI channel, or by including the appropriate MIDI programming code in the string. The programming codes for your instrument should be listed in its handbook and can be sent to it from the Spectrum 128 by including the letter Z in the string, followed by the MIDI code number.

If your synthesizer understands key velocity (so that the program you send it controls the volume at which it plays) this is interpreted from the V settings in the strings. It is calculated at eight times the volume set by the V command, so it takes the values 0, 8, 16 . . . 120. The key release velocity when a note is switched off is sent as 64. If the synthesizer is not designed to understand key velocity, it will play the same volume regardless.







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# ZX Spectrum 128

Introduction

