



**FULLER BOX
GAMES UNIT
FOR ZX SPECTRUM**

**INSTRUCTIONS
FOR OPERATION**

DESIGNED & MANUFACTURED
BY **FULLER MICRO**
LIVERPOOL
71 DALE STREET, LIVERPOOL
Telephone 051-236 6109

INTRODUCTION TO THE FULLER BOX

In line with our policy of combining innovative products with economy, we have introduced the FULLER BOX, designed as the ideal games unit for the ZX Spectrum.

The unit has five main features:

1. Programmable Sound Generator
2. Joystick Controller
3. BEEP Amplifier
4. Cassette Interface
5. Through Bus

OPERATION OF THE PROGRAMMABLE SOUND GENERATOR (PSG)

At the heart of the Fuller Box lies the well known AY-3-8912 PSG chip.

The chip has 14 internal registers, each dealing with its own specific operation.

To create sound effects or music the user must enter the necessary data into these registers.

The user must first select the desired register, then enter the data.

From BASIC these operations are obtained by two 'OUT' commands:

To select the register – OUT 63, REG
To enter data into REG – OUT 95, DATA

For example, to put data 100 into register 6:
OUT 63,6: OUT 95,100

REGISTER FUNCTIONS

Registers 0 – 5 are three pairs of tone value registers, for each of the three sound channels A, B and C.

0 and 1 are FINE and COARSE for channel A
2 and 3 are FINE and COARSE for channel B
4 and 5 are FINE and COARSE for channel C

The COARSE values lie between 0 and 15 (high pitch to low pitch).
The FINE values lie between 0 and 255 (high – low).

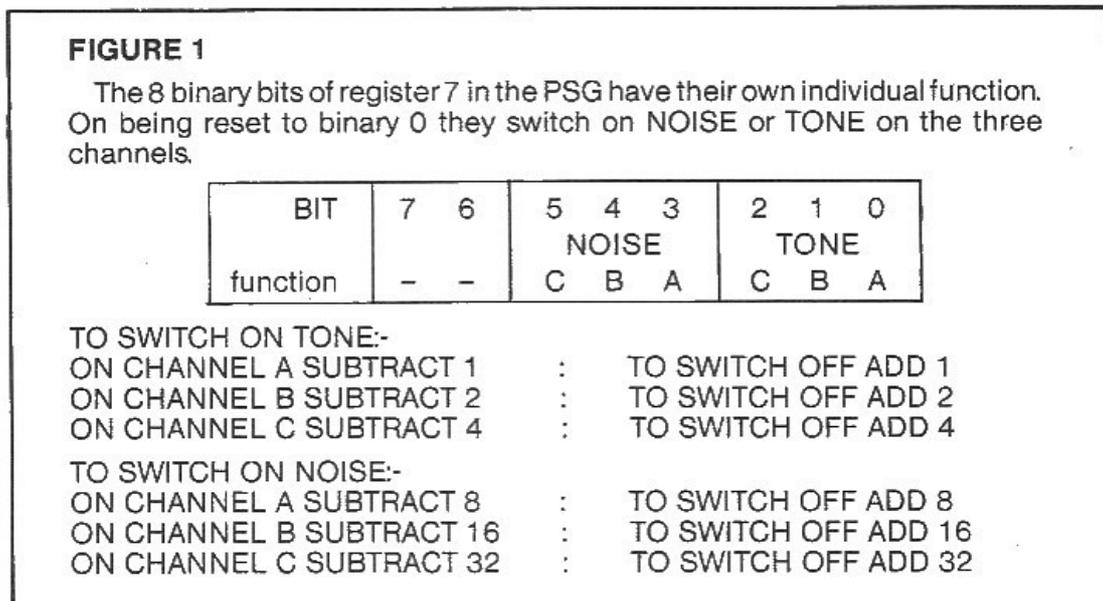
Register 6 is the filter frequency of the built in white noise or hiss generator.

Values range from 0 for a high “ssssh” to 31 giving a low “grumble”.

Noise is available at any time on any of the three sound channels, register 6 controlling the overall filter frequency.

Register 7 is the “switching” control of the PSG chip. The 8 binary bits that make up the decimal number of the data in register 7 have their own individual purpose.

They are used to switch on TONE and/or NOISE on any of the three sound channels. See Figure 1 for details.



Subtract or add numbers from current contents of the register to turn on TONE or NOISE.

So, for example to switch on NOISE on channel B:

10 OUT 63, 7 : REM select register 7
 20 OUT 95, (255-16) : REM bit 4 low

to hear this, set volume of channel B to a medium level:

30 OUT 63, 9 : REM select register 9 – volume of channel B
 40 OUT 95, 8

to turn the NOISE off:

50 OUT 63, 9 : OUT 95, 0
 or 50 OUT 63, 7 : OUT 95, (255-16+16)

both these lines have the effect of turning off the NOISE on channel B.

Registers 8, 9 and 10 are the volume level controls for channels A, B and C respectively.

Values between 0 and 15 (silent to loudest) are used. Any value greater than 15 in any of the three registers will transfer volume control of that channel to the automatic envelope generator.

Registers 11 and 12 set the length of time for one envelope cycle (initial rise in volume to final decay).

Register 11 is the FINE control with values 0 to 255 (fast to slow).

Register 12 is the COARSE control with values 0 to 255 (fast to very slow).

Register 13 is the envelope shape selector. There are a number of pre-set envelopes for use, a table of these is given in Fig. 2.

EXAMPLES

Bomb drop and explosion.

10 LET r=63: LET d=95	(r=register : d=data)
20 OUT r,7: OUT d,254	(switch on TONE on channel A)
30 OUT r,8: OUT d, 15	(select max. volume for channel A)
40 FOR g=40 TO 150	
50 OUT r,0: OUT d,g: PAUSE 2	(whistle as bomb falls using reg. 0)
60 NEXT g	
70 OUT r,0: OUT d,0	(no tone in effect)
80 OUT r,7: OUT d,247	(switches on NOISE & switches off TONE)
90 FOR f=0 to 31	
100 OUT r,6: OUT d,f	(create explosion using varying
110 PAUSE 5: NEXT f	frequency of noise register 6)
120 PAUSE 25: OUT r,7: OUT d,255	(switch off everything)

Telephone ringing.

10 LET r=63: LET d=95	(r=register : d=data)
20 OUT r,7: OUT d,254	(switch on TONE on channel A)
30 OUT r,8: OUT d, 15	(select max. volume for channel A)
40 FOR f=1 TO 2	(two rings in one cycle)
50 FOR g=1 TO 5	(five 'pings' per ring)
60 OUT r,0: OUT d,140	(select note)
70 PAUSE 2	
80 OUT r,8: OUT d, 15	
90 OUT r,8: OUT d, 0	(single 'ping')
100 NEXT g	
110 OUT r,8: OUT d, 0	
120 PAUSE 12: NEXT f	(next ring)
130 PAUSE 50: GOTO 30	(next cycle)

Simple music program

```

10 LET r=63: LET d=95           (r=register : d=data)
20 OUT r,7: OUT d,254          (switch on TONE on channel A)
30 OUT r,8: OUT d, 15          (select max. volume for channel A)
40 READ x                       (get tone value from DATA)
50 IF x=999 THEN RESTORE:
   GOTO 40
60 OUT r,1: OUT d,x             (COARSE tone value)
70 READ y                       (get next tone value)
75 IF y=999 THEN RESTORE:
   GOTO 40
80 OUT r,0: OUT d,y             (FINE tone value)
90 PAUSE 10: GOTO 40
100 DATA 6,174,1,172,5,1,2,59,4,117,53,2,129,5,24,999

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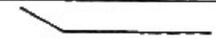
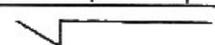
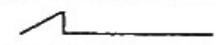
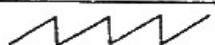
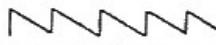
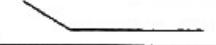
Phasor gun

```

10 LET r=63: LET d=95           (r=register : d=data)
20 INPUT "press 'ENTER' to fire";a$
30 OUT r,8: OUT d,15            (select max. volume for channel A)
40 OUT r,7: OUT d,254          (turn on TONE on channel A)
50 OUT r,0: OUT d,110
60 OUT r,1: OUT d,0             (set up start pitch)
70 FOR f=110 TO 254 STEP 5
80 OUT r,0: OUT d,f: NEXT f    (sweep through frequency)
90 OUT r,8: OUT d,255          (switch off TONE)
100 GOTO 20                     (repeat)

```

FIGURE 2 ENVELOPE SHAPE CONTROL (REGISTER 13)

Data	Envelope Shape	Data	Envelope Shape
0 to 3		11	
4 to 7		12	
8		13	
9		14	
10		15	

For further examples LIST the supplied demonstration program and see how to make more sounds.

Enter your own numbers into the registers using the demo program. See how easy it is to use.

JOYSTICK CONTROLLER

The Fuller Box has a socket to allow connection of any commercially available joystick such as Atari, Commodore, Competition Pro, Diskwasher, etc.

The stick works as an input device on port 127. This means that the value presented to port 127 will change according to which direction the stick is being pushed, or if the fire button has been hit.

Please note that no joysticks work in conjunction with any particular keys without the aid of software. So, to make your own games work with a joystick you will need to add or change a few program lines.

The binary value of port 127 is normally 11111111 or decimal 255. This value is changed when you move the joystick. Certain bits of port 127 are pulled low to binary 0 by the stick. The actions of the bits are as follows:

BIT	7	6	5	4	3	2	1	0
ACTION	FIRE	—	—	—	RIGHT	LEFT	DOWN	UP

So when going up, bit 0 is low and port 127 contains the value (255-1)=254.

Type in the following line of program.

```
10 PRINT IN 127: POKE 23692,0: GOTO 10
```

Move the stick around and see how the value changes. (The POKE makes the screen scroll automatically).

The values obtained are:

UP = 254	RIGHT = 247	DOWN & RIGHT = 245
DOWN = 253	FIRE = 127	UP & LEFT = 250
LEFT = 251	UP & RIGHT = 246	DOWN & LEFT = 249

Note that moving in any direction *and* firing will simply give a number 127, less than the value for that direction.

To use the joystick in your own games, simply replace a BASIC statement such as:

```
IF INKEY$ = "5" THEN _____ (move to the left)
with: IF IN 127=251 THEN _____ (as before)
or:   IF INKEY$="F" THEN _____ FIRE _____
with: IF IN 127=127 THEN _____ FIRE _____
```

All Imagine Software games will work automatically with the joystick controller. However, if any of your commercial software won't work please contact the manufacturers, they will be glad to offer advice and assistance.

BEEP AMPLIFIER

The Spectrum's own speaker is insufficient to produce a reasonable volume for the BEEP command.

Your Fuller Box will also amplify the Spectrum's BEEP command, so adding an extra dimension to all your existing games.

The volume of the Fuller Box is adjustable by means of a small pre-set control which you can alter if desired with a small screwdriver or knife blade or hairpin or similar.

Once set up, the volume should need no further alteration.

CASSETTE INTERFACE

Many Spectrum users experience difficulty when LOADING and SAVEing programs since their cassette recorder needs to have one or the other tape lead disconnected during the operation.

The Fuller Box has an electronic interface which switches the tape lead automatically during a LOAD or SAVE, so eliminating the need for you to do it.

THROUGH BUS

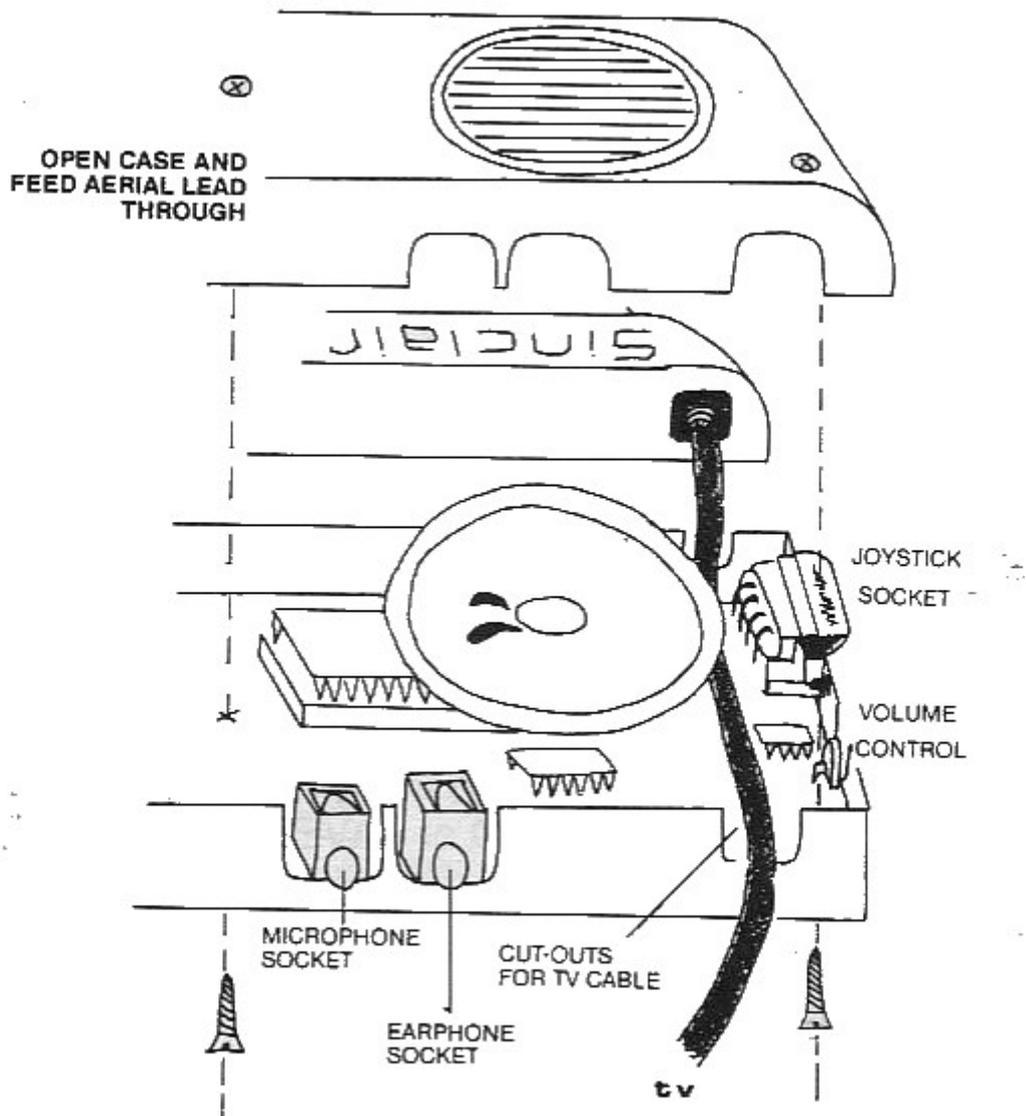
Some Spectrum add-ons do not allow the addition of further peripherals because they lack a through bus.

We at Fuller Micro realized that you will need to be able to plug in the Sinclair printer or the new Microdrives or the Fuller PRINTERFACE, so we've made provision for this by reproducing the Spectrum's rear expansion port on the rear of your Fuller Box.

As well as allowing external expansion, the Fuller Box can be expanded to the capabilities of the MASTER UNIT, with speech facilities to make your Spectrum talk back to you.

Contact Fuller for further details of the expansion – available now, not promised as 'coming soon'.

HOW TO CONNECT THE FULLER BOX GAMES UNIT TO YOUR SPECTRUM



When you receive your Fuller Box you will need to unscrew the bottom half of the case.

This will allow you to feed your TV cable through the box (See Diagram). Place the TV cable, with the correct plug facing the Spectrum socket, across the two cut-outs and screw the case together again.

Plug in the TV cable to the Spectrum and plug the box into the back of the Spectrum so it fits flush to the case.

REMEMBER that there should be no power supply attached when connecting or disconnecting the Fuller Box to your Spectrum.