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ZX Spectrum Neo

User Manual

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ZX Spectrum MUMIO devices
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v.3

We present to you the ZX Spectrum Neo, a modern hardware reconstruction of the ZX Spectrum series computers produced between 1982 and 1991: models 48, 48+, 128, +2, and +3, all housed in the casing of the oldest among them—the ZX Spectrum 48, colloquially known as the "Rubber Keyed Speccy".

The ZX Spectrum Neo is based on the Sizif-512 platform, created by Eugene Lozovoy. This platform is electronically compatible with the original ZX Spectrum computers. It utilizes the original Z80 processor and the AY-3-8910 sound chip, while other components have been replaced with modern equivalents (RAM and ROM) or recreated using contemporary CPLD technology.

To make the computer more user-friendly compared to the originals from the '80s, several modern solutions designed in the 21st century have been added: support for SD card readers, the esxDOS operating system and Bluetooth connectivity.

And if you enjoy experimenting with electronics, the interior of the computer hides other exciting possibilities: connecting to the internet, using a PS/2 keyboard, GPIO outputs for electronic tinkering, the ability to connect CGA/EGA monitors and – with VGA/HDMI converters – even more display options, or adding a dedicated sound card.

Have fun!

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Creators

The ZX Spectrum Neo computer is the work of many engineers and enthusiasts from around the world who, from the 1980s to today, have devoted their time to developing the ZX Spectrum platform.

The 80's

Sir Clive Sinclair
Creator of the legendary ZX Spectrum computer, for which he was received the major honour of a knighthood in 1983

Rick Dickinson
"Shaped the design" of the ZX80, ZX81, and ZX Spectrum computers at Sir Clive Sinclair's company

Nigel Searle
Managing Director of Sinclair Research, overseeing the financing of the company's operations and sales development

Jim Westwood
Chief Engineer at Sinclair Research Ltd

Steven Vickers
Main creator of the firmware embedded in the ROM of early Sinclair computers

Richard Altwasser
Worked on designing hardware solutions used in Sinclair computers

Present times

Eugene Lozovoy (2021)
The author of the Sizif-512 platform project and its system software

Mario Prato (2012)
The author of the SD card handling system called DivMMC

Miguel Guerreiro i Papaya Dezign (2005-2013)
The authors of the esxDOS operating system

Bob Fossil (2020)
The author of a file browser for esxDOS that supports long file names

Geoff Wearmouth (2017)
The author of modified versions of the BASIC ROM: Gosh Wonderful and Looking Glass

Andrew Owen and his team (2008)
The authors of the ULAplus™ extended graphics system

Phil Ruston (2022)
The Retroleum Diagnostic program author

Brendan Alford i Dylan Smith (2018)
The authors of the ZX Diagnostics diagnostic program

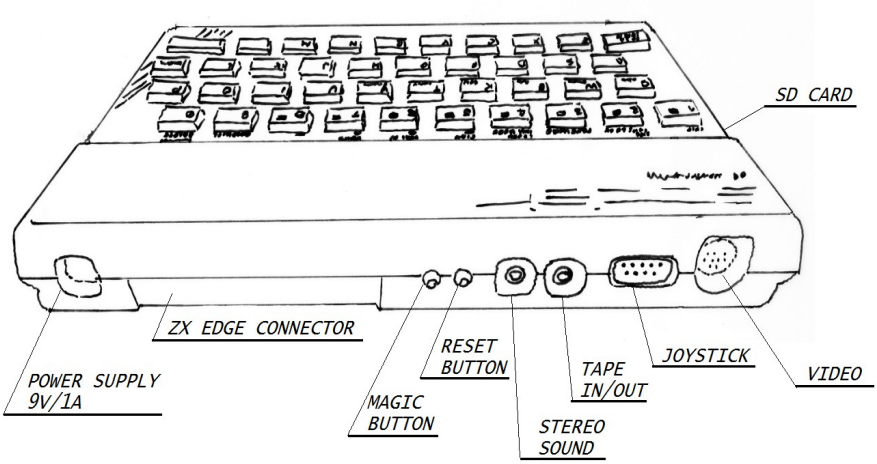
Alexey Zhabin (2007)
He developed the universal peripheral controller Z-Controller

Garry Lancaster (2000 - 2017)
the author of IDEDOS, an additional enhancement to the +3e operating system for the ZX Spectrum +3

Jarek Adamski (2006)
He developed an extended IDEDOS scheme allowing the coexistence of +3DOS with FAT16/32

The owner of the copyrights and trademarks for Sinclair, ZX Spectrum and the original ZX Spectrum computer designs from 1982-1991 is Amstrad/Sky PLC.

System overview



VIDEO – MiniDIN9 connector for connecting a TV or monitor, compatible with SEGA Genesis 2 and Mega Drive 2 console standards. The connector outputs RGB signals, composite video, stereo sound from the AY sound chip, and mono sound from the ULA chip. Use a Mini DIN to SCART cable from SEGA consoles (9-pin).

JOYSTICK – Joystick connector. Default standard is Kempston (compatible with Atari XL/XE, Commodore 64). Optionally, you can switch to Sinclair mode in the "Sizif-512" menu. The SEGA-DB9 gamepad is also supported.

TAPE IN/OUT – ZX Spectrum tape recorder connector. You can connect a smartphone or tape recorder using a stereo minijack cable to load programs the old-fashioned way. See the "Launching Games/Programs" section.

STEREO SOUND – Minijack connector providing stereo sound output by mixing signals from all sound generators in the Sizif.

RESET BUTTON – Resets the processor. Does not clear the RAM.

MAGIC BUTTON – A short press launches the esxDOS file browser. Holding it longer opens the Sizif-512 hardware menu. In practice, a short press triggers the processor's NMI interrupt, which can be individually handled by software.

ZX EDGE CONNECTOR – Universal connector for attaching additional ZX Spectrum peripherals: printers, disks, sound cards, program cartridges, MUMIO devices. Fully compatible with the original ZX Spectrum 48k connector. See notes in the "List of verified external interfaces" section.

POWER SUPPLY – Power socket for 9–12V, minimum 1A. Accepts any contact polarity;

SD CARD – Micro SD card slot. The card should be formatted in at least FAT32/FAT16 standard with the esxDOS operating system loaded on the first partition. The computer can operate without the card, but it will function as a regular ZX Spectrum without the esxDOS system. External expansions may deactivate the SD CARD and add their own support; see the "List of verified external interfaces" section.

First steps

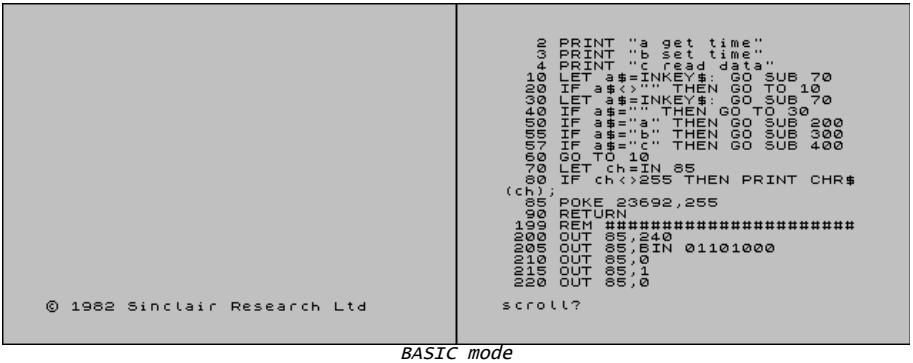
When esxDOS is enabled, a startup screen will appear during the computer's boot process, after which the computer will enter the standard BASIC interpreter mode. If the esxDOS system is disabled, the computer will go directly to BASIC mode or to the startup menu of newer models like the ZX Spectrum 128/+3e/Pentagon.



Startup screen

BASIC mode is the main operating mode of the original ZX Spectrum computer. In this mode, you can enter individual BASIC language commands, manually input a program line by line or load a program from a tape recorder using the command LOAD "".

In this mode, esxDOS system commands that start with a dot (so-called "dot commands") are also available, such as: .ls, .cd, .tapein, .drives



BASIC mode

Press the **MAGIC** button at the back of the computer to enter the esxDOS **File Browser** mode. In this mode, you can browse the contents of the SD card, launch games and programs, or save the current state of the computer to a file. You can view the list of available keyboard shortcuts by pressing the **H** key. Return to BASIC mode by pressing the **SPACE** key.

In this way, you can switch between the two main modes: BASIC and the file browser:

- **MAGIC** – to go from BASIC mode to the browser
- **SPACE** – to go back the other way

If you press and hold the **MAGIC** button for more than 1 second, the Sizif-512 menu will appear, where you can change hardware operation parameters.

Launching Games/Programs

From a SD card

This is the most convenient and fastest way to load games. Loading time is 1–2 seconds.

Press the **MAGIC** button – the file browser (esxDOS system) on the SD card will launch. Then, use the up and down arrow keys to select the appropriate folder with games (default is GAMES), and press ENTER. A list of game files will appear. Choose the desired file and press ENTER. Voila! But that's not all...

During the game, you can return to esxDOS at any time by pressing the MAGIC key. To return to the game, press SPACE. You can switch back and forth like this multiple times.

In esxDOS mode, you can save the game state to the SD card by pressing the S key. A file named **SNAPxxxx.SNA** will be created in the current folder. The file contains the current snapshot of the entire system along with the running game. You can restore the game state from the moment it was saved by launching the **SNA** file with the ENTER key.

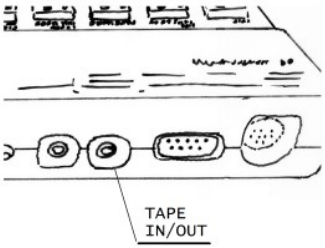
From a cassette

This is the traditional way of loading ZX Spectrum games in the 1980s when the only available medium was cassette tapes, and other media like floppy disks or the Microdrive were often beyond the user's financial reach. ZX Spectrum games were most commonly supplied on cassette tapes. The loading time is up to 5 minutes for the ZX48k.







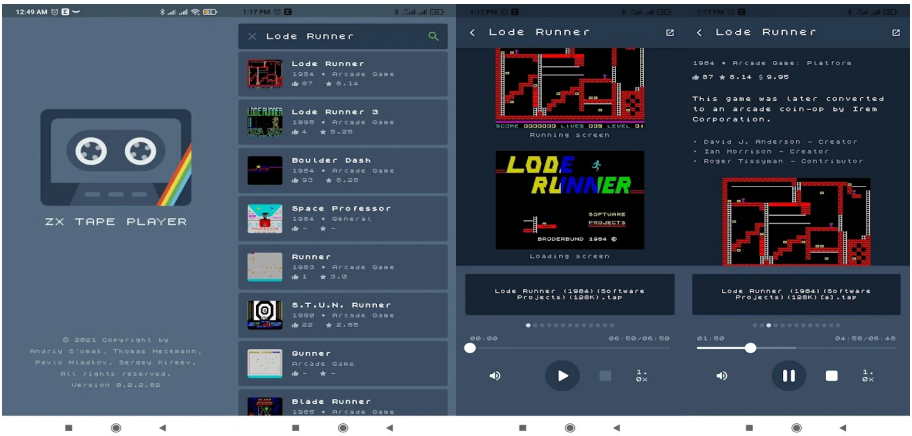


Connect an audio source—a tape recorder (smartphone, MP3 player) to the computer using a stereo, two-ended 3.5mm minijack cable. On the computer side, plug the cable into the **TAPE IN/OUT** jack. In BASIC mode, enter the command LOAD "", press **ENTER**, and simultaneously start playing the tape on the tape recorder. You can specify the name of the program to load within the quotation marks; empty quotation marks mean that the first encountered program or data set from the tape will be loaded. The ZX Spectrum does not control the operation of the tape recorder.

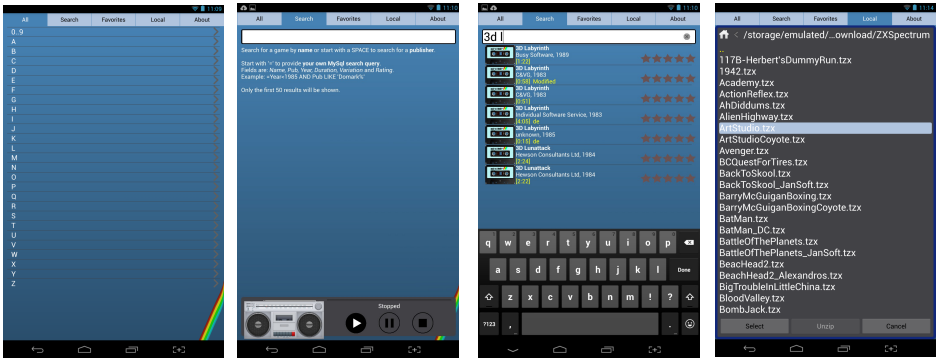
From a smartphone via Bluetooth

This is equivalent to loading games from a tape recorder, with the difference that instead of a tape recorder, you use an Android smartphone with the ZX Tape Player app. Instead of a minijack cable, you can use the Bluetooth wireless connection, which the ZX Spectrum Neo is equipped with.

Install the ZX Tape Player app on your smartphone, downloaded from **apkcombo.com** (currently, the app is unavailable through Google Play) as an **xapk** file using **xapk_installer** (available on Google Play). This app provides an extensive online library with several thousand games and programs for the ZX Spectrum.



Another app with similar capabilities is also available on Google Play – **PlayZX**



Pair your smartphone with the ZX Spectrum Neo's Bluetooth module. After turning on the computer, the device will appear as MH-M18.

In BASIC mode, enter the command LOAD "", press ENTER, and simultaneously start playing the selected game/program on your smartphone.

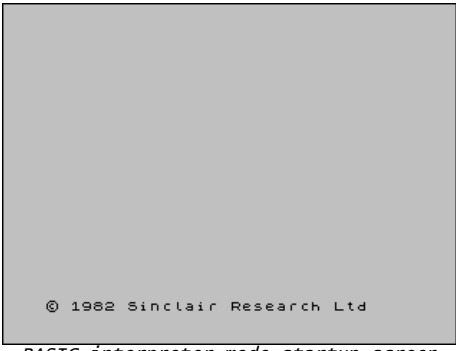
If your laptop or PC has Bluetooth, you can use the **Tapir 1.0** program.



You can also traditionally use a 3.5mm minijack cable from your PC's sound card.

BASIC Language interpreter mode

Basics of the BASIC Language



BASIC interpreter mode startup screen

The above screen is the "programmer" mode, where the computer will execute the commands you issue in the BASIC programming language. This is the basic and formerly the only operating mode of the ZX Spectrum 48 kB computers. In this mode, you can also write a sequence of such commands in the form of a computer program. See how easy it is!

If you type…

```
PRINT "Hello World"
```

…and press **ENTER**, the computer will immediately execute the command and display "Hello World" in the left corner of the screen. But this is not yet programming.

To start programming the computer, you need to place a line number at the beginning of the line:

```
10 PRINT "Hello World"
```

When you press **ENTER**, the computer will not execute the command immediately but will store this line in its memory under line number 10. To have the command executed, you need to run your program.

```
RUN
```

Congratulations! You have just written and run your first computer program!

The principle is simple: if a command is preceded by a number, it will be saved into memory as a line of the program, which you can later run using the **RUN** command. If you do not place a number at the beginning of the line, the command will execute immediately after pressing **ENTER**. Every computer program consists of many lines that are executed one after another, starting with the one with the smallest number, then the next, and so on. In this case, the program starts from line 10. If you add another line numbered 20…

```
20 PRINT "I am alive!"
```

…and run it with the **RUN** command, the computer will first execute line 10, then line 20, and will again finish executing the program. In the left corner of the screen, the following text will appear:



Program code (on the left) and its output.

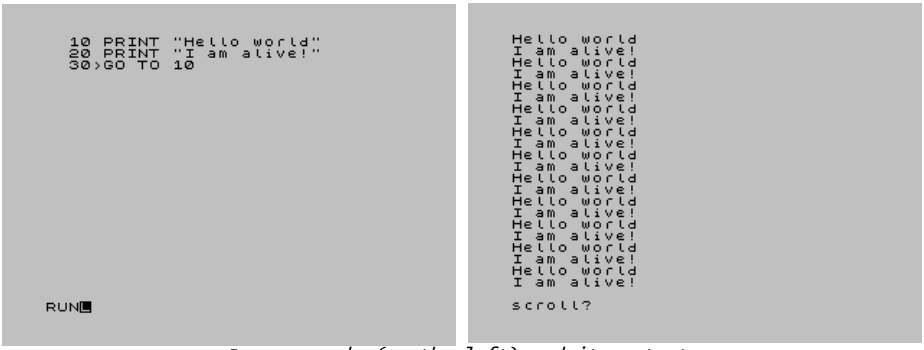
The message 0 OK, 20:1 at the bottom indicates that the program has finished its execution without errors on line number 20.

Another very important command in BASIC is GO TO <line number>. This means that instead of executing the next line, the program must jump to the line with the specified number and continue its execution from there.

```
30 GOTO 10
```

Our program will execute line 10, then 20, and then 30, where there is a command to jump to line number 10. It will execute line 10 again, then 20, and then 30, where there is a command to jump to line number 10. It will execute line 10 again...

Wait! Yes! It will keep doing this endlessly!



Program code (on the left) and its output.

To stop such a continuously running program, press the key combination **CAPS SHIFT + BREAK**.

In the past, the most commonly used BASIC command by players (which was almost everyone) was…

```
LOAD ""
```

This command activates the program loading mode from the tape recorder. After loading was completed, the program would start automatically.

This booklet is not a manual for programming in BASIC. We provided these examples so you could understand the basics. You can also try executing other simple BASIC commands like LIST, BORDER 1, PAPER 0, INK 3, CLS, PRINT PI, connect a joystick and execute PRINT IN 31, and so on. All available BASIC commands are printed on the keys.

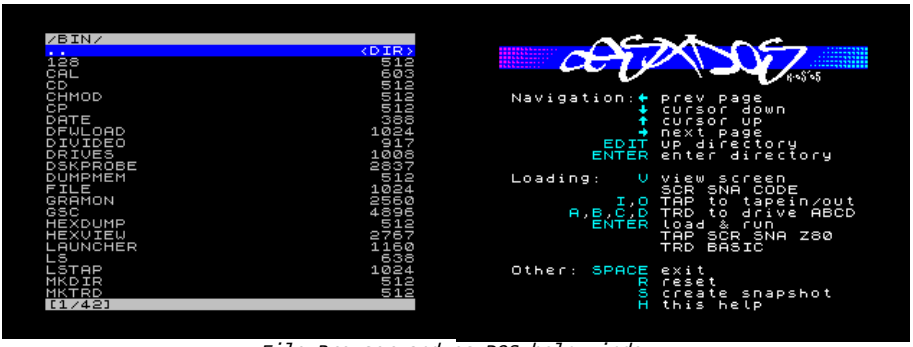
esxDOS Disk Operating System

esxDOS is a disk operating system that extends the BASIC mode of standard ZX Spectrum computers. Previously, in DivIDE interface, it was installed as an expansion card at the back of the computer. In the **ZX Spectrum Neo**, this interface is a built-in element of the hardware platform.

The **esxDOS** support will start if an SD card with the system is inserted and the appropriate configuration parameter is enabled in the hardware menu.

Pressing the **MAGIC** key will launch the file browser, where the following keys are functional:

- **ARROW KEYS** – navigate through folders
- **EDIT** – exit to the parent directory
- **ENTER** – enter a directory or run a **TAP, SCR, SNA, Z80, TRD**, or BASIC file
- **V** – preview the screen saved in an **SCR, SNA,** or **CODE** file
- **I, O** – mount a TAP file for reading (I) or writing (O). This is equivalent to the **.tapein** and **.tapeout** commands described in the **"Dot Commands" – The esxDOS commands"** section.
- **A, B, C, D** – mount a **TRD** file as a TR-DOS system disk
- **SPACE** – exit to BASIC mode
- **R** – reset the computer
- **S** – save (freeze) the entire system state to an SNA file
- **H** – display the esxDOS help window



File Browser and esxDOS help window

Cold and warm restart of the computer

Turning off the computer from the power supply every time you want to load a new game is not very healthy for the electronics. Whenever possible, perform a reset instead of turning it off and on.

Pressing the **RESET** button restarts the computer in BASIC mode but does not reboot the entire esxDOS system. This is called a "**warm start**". In many cases, such a start is sufficient, although it does not clear the RAM, and some games and programs may be resistant to it.

By pressing the **RESET + SPACE** key combination, a so-called "**cold start**" occurs. The entire esxDOS system is launched. It's equivalent to turning computer off and on again.

Application autostart

If you frequently use a particular game, it's convenient to configure the system to launch it automatically when the system starts. This is possible only for games loaded from the SD card using esxDOS.

To do this, write a short loading program in BASIC:

```
10 .cd /games
20 .tapein dizzy.tap
30 CLS : PRINT „Press any key or BREAK..."
40 PAUSE 250
50 LOAD ""
60 STOP
100 .cd /sys
110 SAVE *"autoboot.bas" LINE 10
```

Save it by executing the command GOTO 100. In the above example, after the system starts, the game from the file **/GAMES/DIZZY.TAP** will be launched.

Line 110 causes the program **autoboot.bas** to be saved in the SYS directory in such a way that it will automatically run starting from line 10.

Line 10 (PAUSE 250) is important so that you can modify the program. Without it, you won't be able to change anything in the program because attempting to load it with the command LOAD "" will cause the game to launch every time. The workaround is to load it using MERGE, which attaches BASIC code without running it.

During startup, when the message "Press any key or BREAK..." appears, you can stop autoboot.bas by pressing the **BREAK** key before it launches the game.

In the file ****SYS\CONFIG**ESXDOS.CFG**, change the value of AutoBoot to 1 (edit it on a PC)

```
#AutoBoot
#0=Disabled
#1=Load only on Cold boot
#2=Load only on Warm boot
#3=Load always
AutoBoot=1
```

A value of **1** means that **autoboot.bas** will be launched only during a so-called "cold start" of the system.

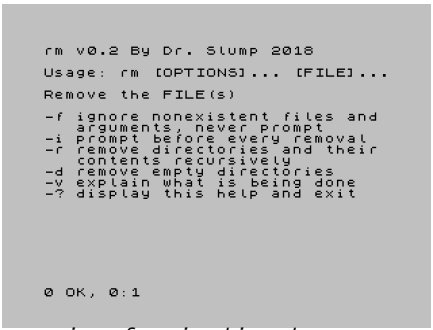
Now you can perform a "cold start" of the computer by holding down the SPACE key and pressing RESET. In this mode, the system will initiate the autostart. If you press RESET alone, the computer will perform a "warm start," skipping your autostart program.

You can also force autostart by using the key combination **RESET + CAPS SHIFT**

„Dot Commands" – the esxDOS commands

When the esxDOS system is enabled, in addition to BASIC language commands, you can use esxDOS system subroutines/commands to extend the capabilities of the language.

The commands start with a dot, hence their common name "dot commands". These programs are located in the BIN folder on the SD card. If a command requires additional parameters, you can invoke it without parameters – in that case, a brief instruction will be displayed. In practice, the most commonly used commands are:
.tapein, .tapeout, .ls, .cd



Instruction after invoking the .rm command.

.ls
Displays the current directory listing of the SD card.

.cd <directory_name>
Changes the current directory to the specified one. Two dots “..” move up one directory level, and a slash “/” moves to the root directory.

.tapein <filename.tap>
Mounts a cassette tape image file (.TAP) in read-only mode. This is equivalent to inserting the appropriate cassette into a tape recorder. From this point, the LOAD commands will read from such a virtual cassette.

.tapeout <filename.tap>
Mounts a cassette tape image file (.TAP) in write mode. From now on, SAVE commands will be executed on such a virtual cassette. Be careful, as this can overwrite an existing program in the .TAP file!

.mkdir <nazwakatalogu>
Creates a new directory with the given name.

.cp <source_file> <destination_file>
Copies the file source_file to destination_file

.rm <filename>
Deletes the file with the specified name.

.drives .partinfo
Displays information about drives and partitions.

.browse
File manager with support for long file names (must be installed as a separate program).

.hexview <filename>
Viewer for file contents.

.date .cal
Displays the current time and calendar, provided the computer has a clock module (RTC) mounted.

All “dot commands” can be executed directly, but can also be inserted into a line of a BASIC program.

Example:

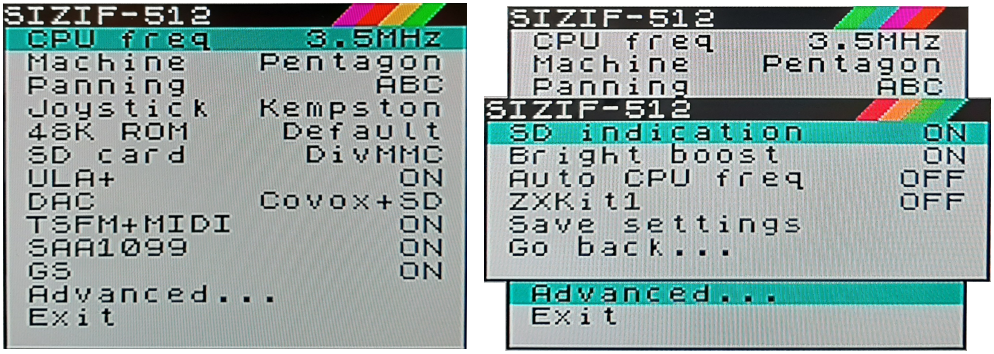
```
10 .cd games
20 .tapein dizzy.tap
30 LOAD ""
```

See the list of available 'dot commands' in “**Recommended literature and links**” section of this document.

Hardware menu

„Sizif-512”

To launch the menu, hold down the **MAGIC** key for 1 second. The menu is responsible for the hardware configuration of the computer. You can navigate the menu using the arrow keys, **ENTER**, and by using a joystick or the keys mapped to the Sinclair joystick (6, 7, 8, 9, 0).



Sizif 512 Menu

CPU freq
Changing the Z80 Processor Clock Frequency. The default frequency at which the original ZX Spectrum was clocked is **3.5 MHz**. Changing this frequency multiplies the computational power and speeds up the computer. However, the vast majority of games and programs were designed for a **3.5 MHz** frequency. Additionally, for serial communication and programs where a strictly defined operating speed is crucial, and timing is calculated by the processor's clock, you should use **3.5 MHz**. Increasing the frequency may be necessary for programs written for the **Pentagon**.

Machine
Type of Emulated Machine and Firmware (ROM). The ZX Spectrum Neo **is not an emulator** and **does not emulate** the operation of these computers in software. Instead, thanks to CPLD technology, it switches the electronics and ROM firmware into the operating mode of the following devices.

- **48** – ZX Spectrum 48kB (1982) (rubber-keyed model) and ZX Spectrum+ (1984). The first computer in the ZX Spectrum series, equipped with **48kB of RAM** and **16kB of ROM**, which contained the BASIC language interpreter.



- **128** – ZX Spectrum 128K (1986) (so called "toastrack") and ZX Spectrum +2 (1986) (gray housing). Equipped with **128kB of RAM** and **32kB of ROM**, alongside the standard 48 BASIC, it features an updated interpreter and editor 128 BASIC, a RAM disk, a three-channel AY-3-8912 sound processor, a MIDI connector, an RS-232 serial port, an RGB monitor output, and an attached numeric keypad. The +2 version had a modified keyboard layout, two joystick ports and a built-in tape recorder.

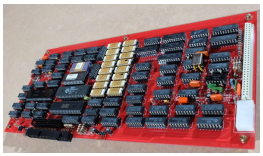



- **+3e** – ZX Spectrum +3/+2A/+2B (1987). equipped with **3-inch disk drives** with a capacity of **170kB per side**. Unlike its predecessors, it had the capability to operate under the **CP/M operating system**. It could free up ROM space for RAM as required by the CP/M system. The **+2A/B** versions featured a tape recorder similar to the earlier +2 version but housed in a gray case.





- **Pentagon** – Shown below in the picture is the "Profi" model. It is one of many versions of the Pentagon, a Soviet clone of the ZX Spectrum 128 developed in 1991 in Moscow by Kondor and Kramis. It features support for additional sound chips such as Covox and Sound Drive, the Beta 128 disk interface, an IDE interface, multi-color graphics (512x240), and many other enhancements. These were predominantly amateurish constructions without specific casings. The ZX Sizif 512 is such a stripped-down machine.



Panning
Mixing modes for stereophonic (Two-Channel) sound from the three-hhannel AY-3-8910 Sound processor.

- **ABC** – channels A and C are left and right, B is mixed into both channels.
- **ACB** – channels A and B are left and right, C is mixed into both channels.
- **Mono** – as in the ZX Spectrum 128k/+2

Joystick
DB-9 joystick connector pinout (supports SEGA DB9 Gamepad Standard)

- **Kempston** – „Kempston" standard. Atari, Commodore 64 compatible joysticks.
- **Sinclair** – „Sinclair" standard. ZX Spectrum +2/+3 compatible joysticks.

Gamepad SEGA DB9

Button	Function in Kempston mode	Function in Sinclair mode
Right	bit0 Right	7
Left	bit1 Left	6
Down	bit2 Down	8
UP	bit3 Up	9
A	bit6 Button3	N
B	bit4 Button1	0
C	bit5 Button2	M
X	bit6 TurboButton3	Turbo N
Y	bit4 TurboButton1	Turbo 0
Z	bit5 TurboButton2	Turbo M
Start	Pause	Pause
Mode	Magic Button	Magic Button

48K ROM
Determines which ROM (16 kB) will be used as the primary BASIC: the original 1982 ZX Spectrum 48 computer or one of the two modern, improved versions.

- **Default** – "Sinclair Research Ltd" from 1982. This is the original ROM installed in factory ZX Spectrum 16/48/+. Its distinctive feature is the ability to enter BASIC language commands with a single keypress. The original ROM also contained errors that were intentionally not corrected during production, including the most well-known NMI interrupt bug.

- **LG** – Looking Glass ROM v. 1.07 z 2018 r. A slightly improved version of the original ROM. Several errors from the original have been fixed. BASIC commands can be entered letter by letter (the so-called "tokenizer"), although this option can be disabled with the STOP command. The original 1982 ROM had a free area of 1,168 bytes, which in the LG version was utilized for additional commands: **STOP, REM, REM k, and REM s**. Additionally, the Looking Glass ROM features a different font.

- **OpenSE** – OpenSE BASIC 2012 r. Developed by Andrew Owen, this is a completely revamped open version of the ROM BASIC. It supports, among other features: ULAplus (including additional graphics modes), sound through the AY-3-8910 chip, direct invocation of machine code, increased memory space for BASIC programs, additional BASIC language commands: **CALL, DELETE, DIR, EDIT, ERASE, FORMAT, MOVE, ON ERROR, PALETTE, RENUM, SOUND.**

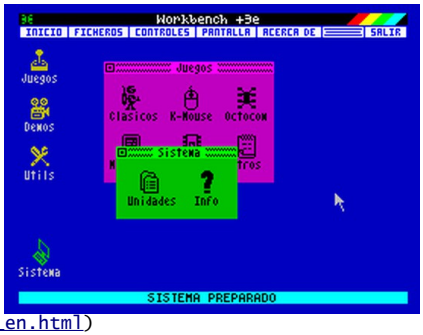
SD Card

- **OFF –** SD card support is disabled. This mode allows restarting the 128kB versions (Pentagon, 128, +3e) using the original menus of these computers.

- **DivMMC** – SD card and esxDOS system support are enabled. In this mode, restarting the computer launches **48BASIC**, and pressing the **MAGIC** button opens the esxDOS file browser.

- **ZC/+3e –** +3DOS SD card support mode is enabled for the ZX Spectrum +3e computer. SD card support is handled through the mechanisms of the Z-Controller expansion card (https://speccy.info/Z-Controller). The SD card must be properly prepared according to the procedure described in the chapter "**Preparing the SD Card for +3DOS Operation**" based on https://worldofspectrum.org/zxplus3e. In this mode, esxDOS does not function. Instead, it is possible to launch the **WORKBENCH +3e** windowed system from the SD card.





(https://octocom.speccy.org/workbench_en.html)

ULA+
Enables support for the extended **ULAplus™** graphics.

The original ZX Spectrum had very limited graphics capabilities: only one mode with a resolution of **256x192** pixels and 8 factory-defined colors (each with two shades except black). The entire image area is divided into **8x8 pixel** squares, and in each of them, only two colors can appear simultaneously.

The graphics capabilities of the ZX Spectrum were managed by a dedicated chip produced by the British company Ferranti. This chip, called ULA (Uncommitted Logic Arrays), was responsible, among other things, for generating the display.



Original ZX Spectrum color palette and ULAplus™ palette.

The ZX Spectrum Neo has a built-in extended version of this chip, called **ULAplus™**, which –**in addition to full compatibility with the original**–can support up to **256 colors** (more precisely, up to **64 colors simultaneously on the screen** from a palette of 256).

DAC
Enables music generation through a Digital to Analog Converter (DAC). In addition to generating sound via the AY-3-8910 chip, the ZX Spectrum Neo has two built-in digital-to-analog converters: a **1-channel Covox** and a **4-channel stereo SoundDrive**.

- **Covox** – 1-Channel Covox on port #FB
- **SD** – 4-Channel Covox stereo (SounDrive) on ports #0F, #1F, #4F, #5F
- **Covox** + SD – Both the **1-Channel** and the **4-Channel** active simultaneously.
- **OFF** – The converters are turned off. The converter ports are not used.

Advanced ...
Launching the extended hardware menu

Exit ...
Exiting the hardware menu:

- Exit – without restart of the computer
- Exit & reboot – with “cold restart”

„Sizif-512” *with the* MultiSound *extension card*

The settings are responsible for enabling the sound modules of the optional **MultiSound** sound card. The capabilities of this card are described in the chapter "**MultiSound Sound Card**”.

TSFM+MIDI
Turbo Sound FM is an evolution of the Turbo Sound device. This device utilizes two YM2203 (OPN) chips instead of the AY-3-8910, ensuring compatibility with software designed for the AY and TS, while also providing 6 FM synthesizer channels. The device is also compatible with the YM2612 (OPN2), meaning it can play Sega MegaDrive/Genesis music, albeit with some limitations. Additionally, the MIDI card allows for the playback of musical notation files (*.mid).

Note!
When this setting is active: The WiFi module (GPIO) on the main Sizif board's AY does not function and the ACB setting in Panning is unavailable.

SAA1099
This is a sound card built around the **6-channel SAA1099** chip by Phillips, which was used in the first SoundBlaster sound cards and the Sam Coupe computer.

GS
General Sound is a sound card interface designed for playing **4-channel MOD modules** (from Amiga and PC computers) as well as individual **samples** (both samples signed by the Amiga and unsigned samples from PCs). It is practically a second computer with its own **12 MHz Z80 processor** and its own **512 kB of RAM**.

„Sizif-512" advanced...

SD indication
Enables/disables the indication of read and write operations to the SD card using colored bars on the bezel. Similar to when loading programs from a tape recorder. Enabling this slows down operations on the SD card.

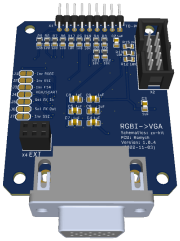
Bright boost
Increases the brightness of the display.

Auto CPU freq
Enables the automatic CPU clock frequency adjustment mode.

- **ON** – The CPU clock frequency is automatically increased to **14 MHz** during esxDOS activity to accelerate read/write operations on the SD card. For **1 ms** after attempting to read/write bits **3** and **4** of port **#FE** (MIC and EAR), the frequency is changed to **3.5 MHz**. This allows loading programs from a tape recorder in turbo mode and improves the sound generated by the "beeper" speaker.
- **OFF** – The computer continuously operates at the frequency set in the **CPU freq** parameter.

ZXKit1
ZXKit1 is an external converter that allows the connection of a VGA monitor. More information can be found at https://github.com/romychs/RGB2VGA. This parameter changes the function of two pins on the **EGA_HDR** connector (J8) on the motherboard to enable the connection of ZXKit1.

- **OFF** – Pins **6** and **7** function as **Vsync** and **Hsync** outputs for EGA monitors
- **ON** – Pins **6** and **7** function as **14 MHz** and **Csync** outputs for ZXKit1 and VGA monitors (however, not all modern VGA monitors support this mode)



ZXKit1

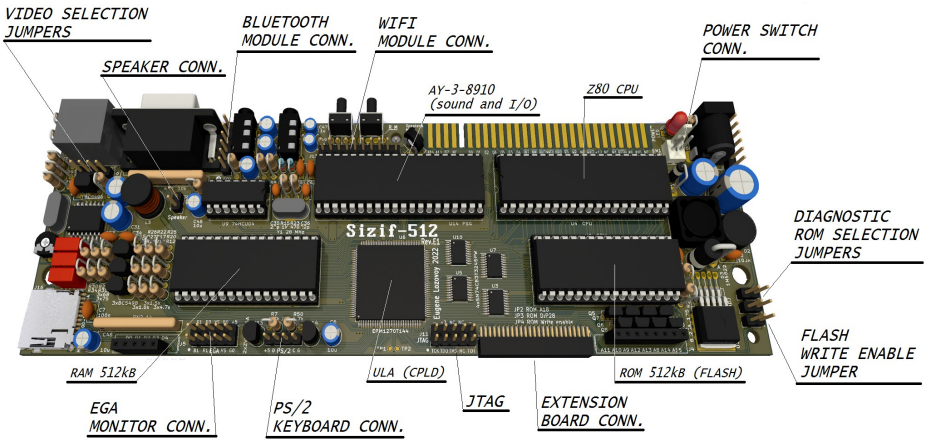
Save Settings ...
When the **FLASH WRITE ENABLE** jumper on the PCB is set, it will be possible to save changes to the hardware settings. Upon restarting the computer, it will boot with the new settings.

Go back …
Return to the main hardware menu

What's Inside the Case?

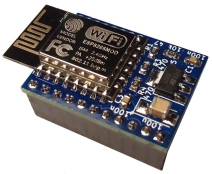
The **ZX Spectrum Neo** offers substantial expansion capabilities with additional modules. Many interesting connectors have not been exposed externally but can present a fascinating challenge if you wish to expand your computer with internet support via WiFi, program uploading via Bluetooth, an RTC clock, a VGA monitor, or add a sound card.

Below we describe the full capabilities of the Sizif-512 motherboard:



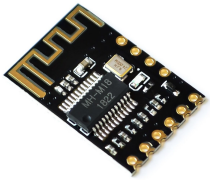
WIFI MODULE
A UART serial connector, as well as parallel 8-bit input/output ports (GPIO), are routed from the AY-3-8910 chip. It is an expanded equivalent of the RS-232 connector found on ZX Spectrum 128 and later models (using TTL signal standards instead of RS-232). Consequently, it is supported by the standard BASIC procedures of these computers. An expansion WiFi module based on the ESP-12 (ESP8266) can be connected to the connector. There is software available for handling internet network services for ZX Spectrum with this module (https://github.com/UzixLS/zx-sizif-512-wifi). This includes a Gopher service client and an IRC messenger.

The network handling software package is located in the **NETWPOK** folder on the SD card included with the ZX Spectrum Neo computer. It can also be downloaded from https://mumio.dev/wp-content/uploads/2024/04/network.zip.



„Sizif-512" WiFi module

BLUETOOTH MODULE
Connector for the MH-M18 Bluetooth audio receiver module. After pairing with a smartphone, the module allows wireless uploading of games and programs, e.g., from the **ZX Tape Player**, **PlayZX** instead of a tape recorder, or from a computer equipped with Bluetooth playing WAV files, or from **Tapir1.0** or others.

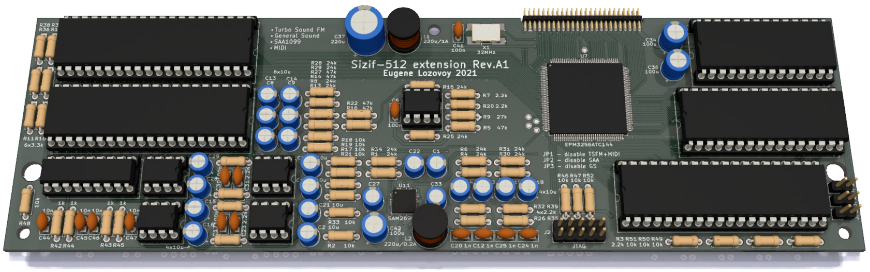


MH-M18 Bluetooth audio module

EGA MONITOR
Connector for an EGA standard monitor. Optionally, it can be used to connect converters for VGA or HDMI outputs.

PS/2 KEYBOARD
PS/2 standard keyboard connector (simple USB keyboards via an adapter will also be detected as PS/2).

EXTENSION BOARD
Connector for the optional **MultiSound** sound card, which expands the computer's capabilities to play high-quality music compliant with standards: **Turbo Sound FM**, **General Sound**, **SAA1099**, and **MIDI**. More about this card is written in the chapter "MultiSound Sound Card".



MultiSound extension card

SPEAKER
Connector for the standard ZX Spectrum speaker (a small amplifier may be needed).

POWER SWITCH
Power switch connector.

JTAG
Service connector for programming the ULA chip

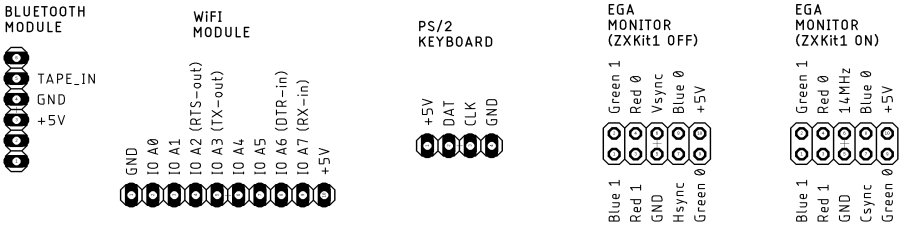
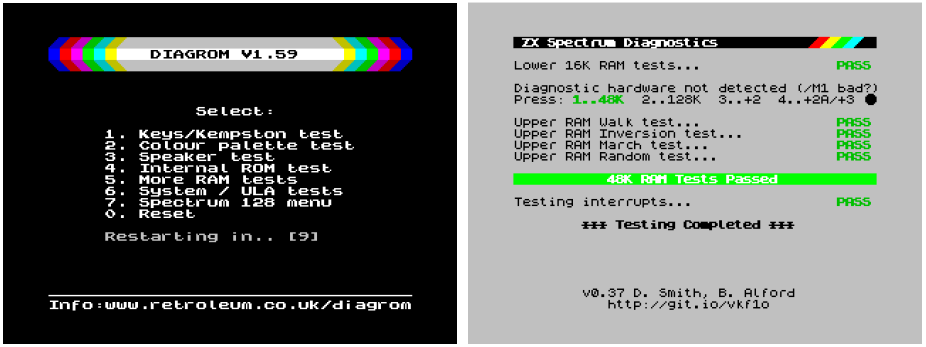


Diagram of connectors hidden inside the case

DIAGNOSTIC ROM SELECTION
Jumper blocks **JP2** and **JP3** allow the activation of diagnostic modes. The system has two built-in diagnostic programs: **DiagROM** by Retroleum and **ZX Diagnostics**. By combining the jumper settings, you can also activate experimental emulation of the ZX81 computer. This mode can also be activated by holding down the **CAPS SHIFT** key during computer startup.





Two of the diagnostic programs build in the ZX Spectrum Neo.

FLASH WRITE ENABLE
Jumper **JP4** unlocks the ability to write to the ROM memory (flash). The ROM memory of the ZX Spectrum Neo computer is of the "flash" type, which means that (unlike the original ZX Spectrum) it can be programmatically written. The system utilizes the ability to write to this memory in two cases: when using the **Save settings...** menu function of Sizif-512 and in the experimental ZX80/ZX81 mode.

Settings will be saved directly in the ROM memory (flash) area so that they are not reset when the computer is turned off. By default, the jumper is set to **write enable**, but to avoid accidentally overwriting the contents of the ROM memory in case of a software error, it can be removed (**write disable**).



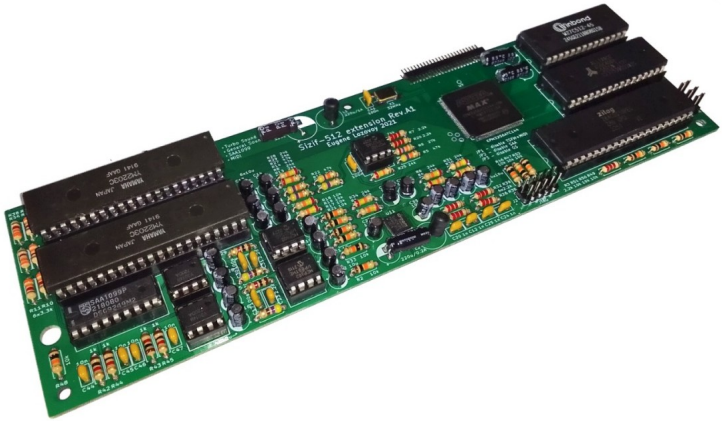
VIDEO SELECTION
The jumper settings redirect video signals depending on the cables being used. These jumpers should not be altered if using the MiniDIN cables provided with the computer (SEGA Genesis 2 standard).

MultiSound Sound Card

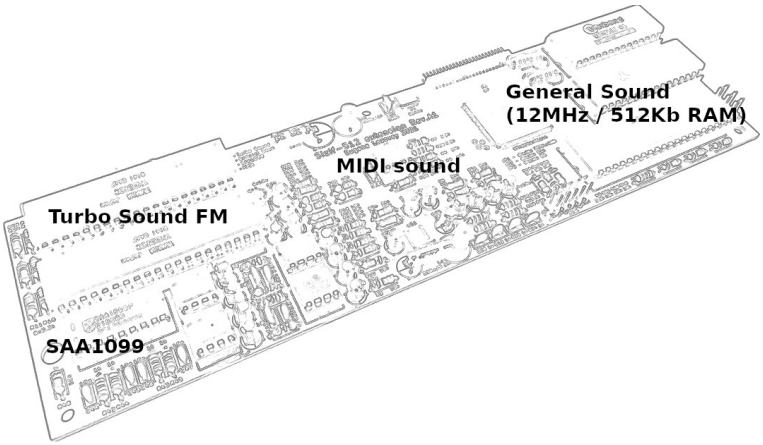
The **MultiSound** sound card is an optional expansion for the ZX Spectrum Neo (Sizif-512) computer. Practically, it contains four separate sound generation systems on one board. Its size is adjusted to fit into the empty lower half of the ZX Spectrum Neo computer case.

Designed by Eugene Lozovoy—the author who designed the Sizif-512 board, the ZX Spectrum Neo's hardware platform.

The MultiSound card is practically a separate computer based on the Z80 processor, with 512 kB of RAM, two **Yamaha YM2203** chips, a dedicated MIDI chip, and the **SAA1099** sound chip..



Construction of the MultiSound card



Turbo Sound FM
This device utilizes two **YAMAHA YM2203** chips. These are equivalents of the AY-3-8910 chips used in ZX Spectrum and Sizif-512. Each of them can generate 3 channels. This gives you 6 channels plus an FM synthesizer. The device is also compatible with YM2612 (OPN2), i.e. it can play Sega MegaDrive/Genesis music, with a few limitations.

MIDI
MIDI allows the playback of musical notation files (*.mid) through synthesized musical instruments stored in the chip. It uses the **SAM2695** processor, featuring samples of **256 musical instruments**, **64-channel polyphony**, **effects** (reverb, chorus), and **stereo** sound.

SAA1099
The **SAA1099** is a sound card built around the **6-channel SAA1099 Phillips** chip, used in the first SoundBlaster sound cards and the Sam Coupe computer.

General Sound
General Sound is a sound card interface designed for playing **4-channel MOD modules** (from Amiga and PC computers) as well as individual **samples** (both samples signed by the Amiga and unsigned samples from PCs). It is practically a second computer with its own **12 MHz Z80 processor** and **512 kB of RAM**.

How to install the card in the ZX Spectrum Neo

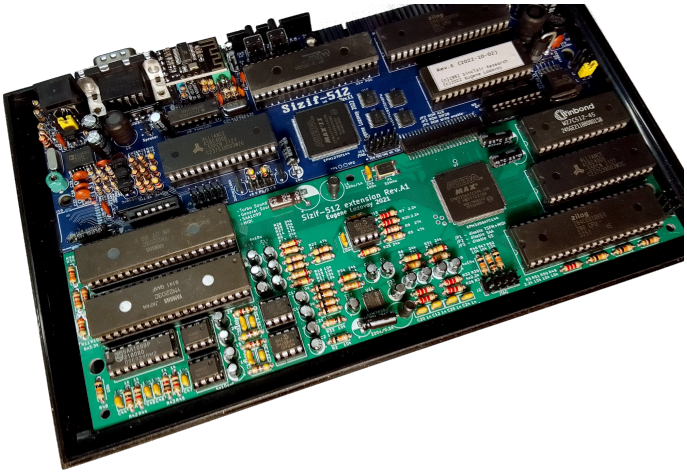
To install your MultiSound sound card, you need to disassemble the ZX Spectrum Neo casing. Before disassembling, disconnect everything from the power supply and disconnect all components, including the SD card. Then unscrew the five screws from the bottom. Carefully lift the keyboard part and disconnect the two keyboard cables from the motherboard.

Remove the ZX Sizif 512 motherboard from the lower part of the case, insert the sound card board into the internal ZX-BUS slot as in the marked photo. This way you will get a set the size of the original ZX Spectrum 48k PCB, insert the resulting whole into the lower housing, insert the keyboard ribbons, fasten the whole thing and screw it back together with screws to form a stable whole.

Keyboard ribbons, internal ZX-BUS socket, jumper group.

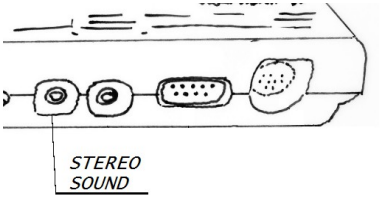
Using three jumpers on the right side at the bottom of the sound card, you can disable the **SAA1099**, **TurboSoundFM + MIDI**, and **GeneralSound** circuits if the MAGIC button is unavailable (e.g., due to an add-on that overrides the MAGIC function). These jumpers also replace the saved configuration, even if the MAGIC button is active.

No Jumper Set: The computer starts with the default ON option.
Jumper Set: The device is OFF, but it can be enabled via the hardware menu.



Mounting Two Boards:
Sizif-512 (Blue) and MultiSound (Green) in the ZX Spectrum Neo Case.

Connecting the speaker set



To use the ZX Spectrum Neo, simply connect standard stereo computer speakers powered via a USB power supply. Use a minijack plug cable to insert into the MIC socket on the back of the computer.

First steps

In the original ZX Spectrum 16k/48k/+ models, there was no dedicated sound chip. The built-in speaker was controlled digitally one-bit by the ULA and the **BEEP** command in BASIC.

From the ZX Spectrum 128 model onwards, the **AY-3-8912** chip was installed. This is a **3-channel sound generator** also used in the Amstrad CPC and, under the name **Yamaha YM2149**, in the Atari ST. Earlier ZX Spectrum models could connect an add-on with the AY-3-8912/10 chip.

In the modern clone, the **ZX Spectrum Neo**, there are additionally built-in **Covox** and **SoundDrive (SD)** chips, which were used in Soviet clones like the **Pentagon**.

Covox is a simple audio transducer. Covox is built from the simplest 8-bit digital-to-analog converter based on a resistor ladder. Single-channel Covox is on the #FB port. **SoundDrive (SD) -** the four-channel Covox stereo ports are #0F, #1F, #4F, #5f.

You can add an additional card to the **ZX-BUS** internal bus of the **Sizif-512** motherboard, greatly expanding the ZX Spectrum Neo's sound capabilities. The **Sizif-512** motherboard and the **MultiSound** sound card, connected together, take up the space of the original ZX Spectrum 48 PCB and fit into the case of the first "rubber-keyed" ZX Spectrum computer.

Additional sound capabilities of the multiSound card:

- **TurboSoundFM**
- **MIDI**
- **SAA1099**
- **GeneralSound (GS)**

Standard capabilities of the Sizif-512 motherboard alone:

- **beeper** – 1-channel, 1-bit standard ZX Spectrum sound
- **AY** – 3-channel sound generated by the AY-3-891x chip
- **Covox i SoundDrive** – 8-bit 1-channel mono and 4-channel stereo.

After adding the MultiSound card:

- **FM** – thanks to the two YM2203 chips, you also have 6 FM synthesis channels, a frequency modulator, similar to music organ keyboards.
- **TurboSound** – using the same two YM2203 chips (equivalent to AY-3-891x), you have 6-channel AY sound.
- **TurboSoundFM** – combines the above technologies, providing 6 AY channels + 6 FM channels.
- **MIDI** – sound system for creating and playing musical notation on over 128 musical instruments stored in memory.
- **SAA** – stereophonic 6-channel sound generator used in the SAM Coupe computer and

sound cards for PC-class computers,

- **GeneralSound** - separate computer that allows playing sound files known from Amiga computers and early PC versions.

You can also add an external **ZX-TSid** card to play sound files from the **Commodore 64**. With this addition, the ZX Spectrum Neo becomes a true audio powerhouse!

Sound file formats and players

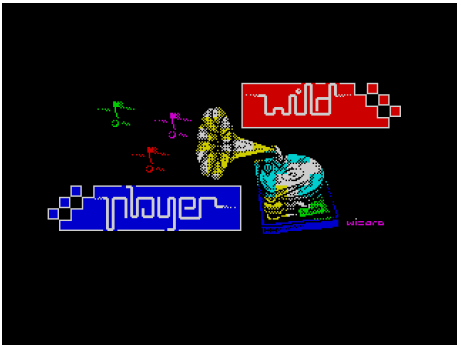
When searching for sound files on the Internet to listen to on a computer with the **MultiSound** card, you will find a multitude of different formats. Most are for the standard **AY-3-891x** sound chip. Below are the extensions assigned to the programs in which these files were created.

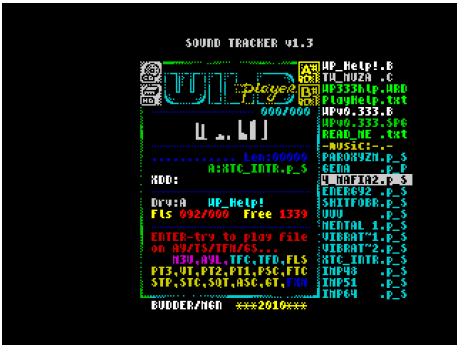
- ***.asc** – ASC Sound Master
- ***.ftc** – Fast Tracker
- ***.fls** – Flash Tracker
- ***.fxm** – Fuxoft AY Language
- ***.gtr** – Global Tracker
- ***.psc** – Pro Sound Creator
- ***.psm** – Pro Sound Maker
- ***.pt1** – Pro Tracker 1.XX
- ***.pt2** – Pro Tracker 2.XX
- ***.pt3** – Pro Tracker 3.XX
- ***.stc** – Sound Tracker
- ***.stp** – Sound Tracker Pro
- ***.sqt** – SQ-Tracker
- ***.tfc** – FM sound files
- ***.pt3** – standard AY (3-Channel) and TurboSound (2xAY, 6-Channel)
- ***.tse** – TurboSound Editor 1.01
- ***.mid** – MIDI notation files
- ***.mod** – General Sound standard
- ***.etc** – SAA1099 standard

Files with the above extensions can also be simultaneously supported by other programs. These are not all the extensions you may encounter.

AY – TurboSound – FM – TurboSoundFM

Wild Player is a fairly universal sound file player with extensive capabilities to play various sound file formats. For the **DivMMC** controller equipped in the ZX Spectrum Neo (**Sizif-512**), you need the version designed for this controller (**wp_divmmc4.z80**) to access the contents of the SD card. You can also freely handle **TRD** image files (**TR-DOS**), allowing access to the sound files located within these files.

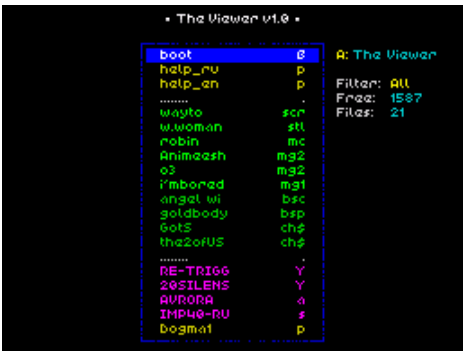




This program can play sound files of the standard AY, as well as **TurboSound** and **FM synthesis** formats, and **MOD** files for the **GeneralSound** card. For proper playback of ***.pt3 TurboSound (6-channel)**, **WildPlayer** requires **256kB of RAM**, so you must run it on the **Pentagon** machine. In the spectrum window, the text "TS!" will appear.

Another fairly universal program for music playback is **The Viewer**. In addition to playing music, it is used for displaying various image formats, as the name suggests. Access to files is possible from **TR-DOS** or through emulation in **TRD** image files.



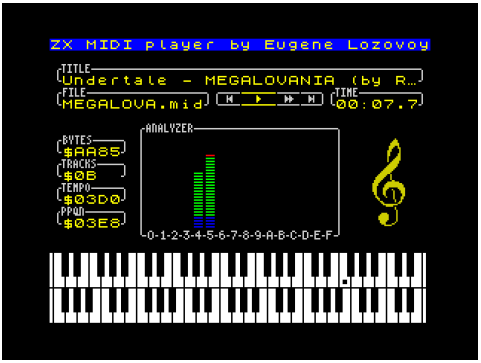


MIDI

To play musical notation files, i.e., the **MIDI** format, you can use the **ZX MIDI Player** from 2023, created by the ZX Sizif 512 clone's designer, **Eugene Lozovoy**. You can download MIDI files from a PC or musical instruments that can generate such files. MIDI files have the extension:

- ***.mid**

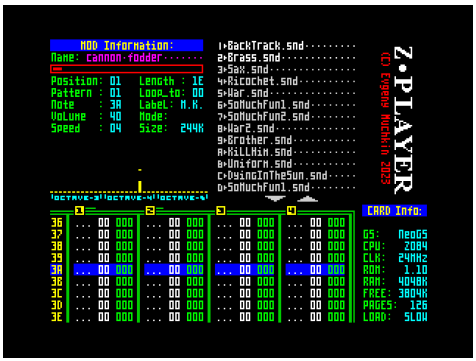




General Sound

General Sound allows playback of **MOD** sound module files from **Amiga** and **PC** computers using the **Z-Player for GS** program. These files are similar to MIDI files, with the difference that MOD files contain short WAV sound samples embedded within the file, making them larger than pure musical notation files. Files in this standard have the extension:

- ***.mod**





SAA1099

The capabilities of the **SAA1099** chip are relatively underutilized. It was installed in the later period of the ZX Spectrum's popularity in the **SAM Coupe** computer and later became an element of early sound cards for PC-class computers. Sound files played on this chip have the extension:

- ***.etc**

They can be played using an esxDOS overlay that allows handling long file names with **.browse**. In the /bin/bplugins folder of this overlay, there is a plugin named **"etc"**. If you are creating your own SD card, you need to add this plugin there, as it is not standardly available in this overlay.

Supported Sound File Extensions in esxDOS and .browse

dotCommands esxDos:

- .playpt3
- .playsqt
- .playstc
- .playtfm (*.tfm, *tfc)
- .playwav (works with divIDE only)
- .tsplay (*.pt3 – TurboSound)
- .playmid (plays "midi 0" format files via MIDI out of original ZX Spectrum)
- .playay (displays headers only?) virtual machine image
- .gsc (plays *.mod files for GS)

bplugins .browse:

- ay plugin for playing **.ay** musical files (?displays headers only?) see above.
- etc (need to be added, not available in .browse standard)
- mid requires the .playmid command in /BIN (see above)
- pt1
- pt2
- pt3
- sqt
- stc
- stp
- wav (only works with **divIDE**)
- mod plays *.mod files for the **GS** card (loops continuously, cannot be interrupted. To interrupt, you have to reset the computer)

To play a sound file, run .browse, enter the directory with the sound file supported by the plugin, hover over the file and confirm with Enter to start playback. To interrupt playback, press the Break key. Using the arrow keys, we move through the contents of the directory and can change the song being played.

Sample Music Editors for ZX Spectrum

Below are a few programs that are simple tools for composing music, processing samples and other tasks related to ZX Spectrum sound.

Turbo Sound v.1.01





Program for the **Pentagon** systems. This program requires **256kB of RAM** to operate and works with **TR-DOS** system disk images.

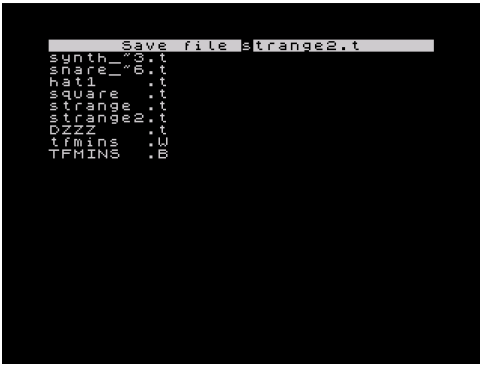
Navigation: Use the QAOP keys to navigate the program menu (acting as screen arrow keys). Press Space to select the highlighted option and Break to return.

Editing/Composing Patterns: When you choose to edit or compose a pattern, navigate through the pattern using the arrow keys (CS + 5678 keys).

Track Editing: Use LI, LII, CI, CII, RI, RII to edit tracks where you enter the parameters of the played instrument/sample/ornament. These parameters can also be edited and saved to disk.

TFM Instrument Editor 0.4





TFM Instrument Editor is a program developed by Alone Coder in 2007. It is intended for editing instruments for Turbo Sound FM. The program allows you to edit the instrument using a set of designated keys on the keyboard. Each key represents a note, pressing the key generates a note-playing event, and releasing the key generates a note-stopping event. The program supports up to 6 simultaneous notes and provides the ability to change the octave using specific buttons. Additionally, you can mute all currently playing sounds by pressing the SPACE button.

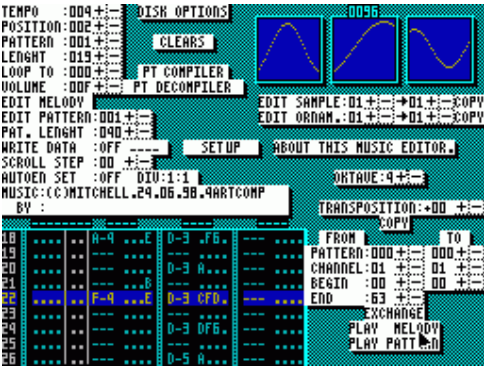
The editing process involves moving the cursor using the arrow keys (CS+5678) and correcting the values using dedicated buttons (CS+34). To change the octave (1-8) use the buttons (SS+VB). Saving the changes made as a new instrument (CS+Enter) Loading the instrument from a floppy disk (trd disk image) (CS+Space).

Notes on the keyboard:

	S	D		G	H	J			2	3		5	6	7		9	0			ss^{L}		
Z	X	C	V	B	N	M	Q	W	E	R	T	Y	U	I	O	P	ss^{8} Y	ss^{9} U	ss^{ZD}					

Pro Tracker 3.31





ProTracker 3.x can load Pro Tracker 2.x files, Sound Tracker, Sound Tracker Pro modules. The program works with TR-DOS diskettes (trd disk images).

To move around the program menu, use the Q, Caps Shift, O, P keys or the Kempston joystick (moving the on-screen arrow). Use the spacebar to select the selected option. To exit the selected option (window), move the screen arrow outside the window and press the Space button. To stop playing/editing melody/pattern press CAPS SHIFT + SYMBOL SHIFT (EXTEND).

Hot-keys:

- W – Melody edit
- E – Pattern edit
- L – Melody playback

Pattern edit:

- GRAPHICS – Beginning of the pattern
- SS+0..8 – steps
- SS+e – copy channel into buffer
- SS+r – paste buffer into channel

Positions list:

- SS+w – insert
- SS+r – remove
- z – Inc
- w – Dec
- 0 – Clr

Moving around and within patterns (CAPS SHIFT + 5678)

Contents of the SOUND folder

Together with the MultiSound card we have prepared a library of tools and music. The archive is located in the **MultiSound.zip** file, where you will find the zipped **SOUND** folder. You can download the archive (almost 2 GB) from the following address:

https://mumio.dev/files/MultiSound.zip

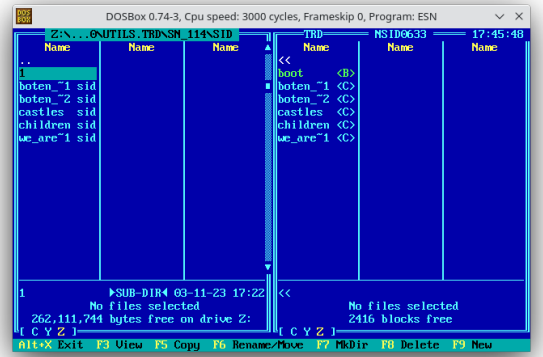
After unpacking, copy the SOUND folder to the root directory of the SD card, ZX Spectrum Neo computer.

Below is a list of subfolders containing tools, programs and sound files.

- **AY** – available to playback on the single AY-8910/12 chip:
  - FastTracker v.1.07 beta 6
  - ProTracker – various versions
  - ProSoundCreator v.1.07
  - SoundTrackerPro
  - softPLAY128 – PLAY command for 128BASIC, available for 48BASIC as **PRINT #8**
  - Modules for test – sound files created in various programs
- **beeper** – for a regular ZX Spectrum 16/18/+ speaker
  - Demos - three demos playing music on a beeper
  - Beepfix7, demo run by trd file, BeepTracker
    (mount trd image file and RUN “BT” under TR-DOS)
- **covox+SD** – 8bit Pentagon computer sound generator
  - Flash_Track
  - SQTracker v.1.0

- **FM** – frequency synthesis for two YM2203C chips
  - TFM Instrument Editor 0.4
  - *.tfc sound files
- **GS** – independent General Sound computer, MOD sound files of Amiga and PC computers
  - Z-Player for GS v.3.3 i v.4.1 supporting divMMC
  - MOD – various music module files in *.mod format
  - MOD plugin for.browse
- **MIDI** – zapis nutowy
  - ZX MIDI Player (Eugene Lozovoy)
  - MusicMachine (pakiet) – additional hardware attachment required
  - Various note music files *.mid
- **multi** – tools and programs that support multiple standards
  - WildPlayer, various versions
  - TheViever1.0
  - ExcessSampleEditor v.1.4, to record wav sound you need an analog microphone attachment (ZX input jack is not enough)
- **SAA** – which you can play on the SAA1099 chip
  - ETC plugin for .browse
  - various demo players with built-in sound files
  - etc directory with *.etc sound files for .browse
- **SID** – designed for playing Commodore 64 SID files, works on an emulator via TurboSound and on an additional TSid hardware card
  - NSID_EMU_TS, SID file player emulator for TurboSound for various ZX machines
  - TSID(HardSID), SID player on hardware TSID for various ZX machines
- **TS** – for two AY-8910/12 or YM2203C chips
  - TurboSound_Editor v1.07
  - TSMusicPack, *.pt3 files directory
- **TSFM** – for combined FM and TS technologies for two YM2203C chips, 6+6 channels
- tape files with a demonstration of the technology capabilities
- **utilPC.trd** – tool for managing *.trd disk images, copying between the PC file system and the trd disk image. Most ZX Spectrum programs only support physical disks and thanks to the esxDOS system, these programs have access to file images of these disks. Unfortunately, from the esxDOS system itself there is no access to the contents of these images.
- **DOSBOX v.0.74**, win32 installer, for other systems visit -> www.dosbox.com

- **ZXSpectrumNavigator v.1.12**, zip archive, unpack and run it in DOSBOX



DOS program "ZX Spectrum Navigator v.1.12"
*allowing to edit *.trd images of TR-DOS diskette files, run in DOSBOX*

ADVANCED TOPICS

FDD +3DOS, BDI-ZX and DivIDE Controllers

A Floppy Disk Drive (FDD) is a peripheral device of the computer designed to handle one type of external computer memory, which is the floppy disk



3.5-Inch Floppy Disk Drive

The role of floppy disk drives has been taken over by writable optical discs and USB media. Today, floppy disk drives are no longer standard in computers. However, in older systems, without these drives, it is impossible to restore the system from a backup or perform certain other essential operations without disassembling the computer.

Gotek Floppy Disk Drive Emulator – Instead of a real floppy drive, you can connect a modern device that allows reading and writing floppy disk image files (various formats depending on the computer it will work on) as if it were a real floppy disk. Floppy disk images are saved and read from a USB stick or an SD card placed in the Gotek drive, depending on what is supported. The large capacity of the solid-state medium allows for a substantial library of various floppy disk images. Image selection is done via Gotek's panel with a knob, buttons, and a small LCD screen.

ZX Spectrum Neo via Gotek supports the following floppy disk image:

- **DSK** – ZX Spectrum +3 floppy disk image
- **TRD** – TR-DOS floppy disk drive image



Gotek Drive Corresponding to 3.5-Inch FDD.

The handling of physical FDD and/or Gotek drives depends on the type of controller used in the ZX Spectrum Neo:

+3DOS floppy controler for +3e	(Supported only in **Machine:+3e** mode)
PLUS 2A FDD Interface for +3e	(Supported only in **Machine:+3e** mode)
BDI-ZX with its own TR-DOS ROM	(Supported in all Machine modes)

“SD Card” settings:

- **OFF** – only access to physical drives
- **DivMMC** – additionally, an SD card with esxDOS and virtual TR-DOS (TRD, SCL) in **Machine:+3e** mode. You must select the **48k ROM as LG** for esxDOS to work
- **ZC/+3e** – Additionally, an SD card with +3DOS (Supported only in **Machine:+3e** mode)

To utilize the full capabilities of **Machine:Pentagon** mode, it is recommended to use the BDI-ZX controller with its own TR-DOS ROM. This controller does not block the Magic menu. In Pentagon mode, you will have access to the entire 512kB RAM and the HE GLUK functions, which are stored in the controller's ROM.

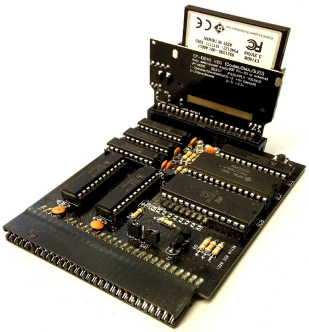
Machine:Pentagon Mode with **SD Card Option:DivMMC** emulates the TR-DOS FDD controller via esxDOS and reads **TRD**, **SCL** floppy disk images. However, the computer's RAM is limited to **256kB**.

When connecting a Gotek drive to an FDD controller, whether **+3DOS/PLUS 2A** or **BDI-ZX**, via a pendrive/SD card, you will have access to the following floppy disk images:

- ***.DSK** (in **+3e** mode and it is the only way to handle these images)
- ***.TRD** (if you don't have a physical controller, you can access images via TR-DOS system emulation in esxDOS)

Advantage of Using a Physical FDD Controller:
You can insert and remove the pendrive while the ZX Spectrum Neo is running, just as you would with a floppy disk. This is not possible with an SD card directly managed by the ZX Spectrum Neo.

The ZX Spectrum Neo also works with the **DivIDE** controller, which disables the internal **DivMMC** but blocks **Magic** and enforces the factory startup configuration **Pentagon**. In this mode, you will have access to the full **512kB RAM** but without **HE GLUK** functions and the ability to change hardware configurations.



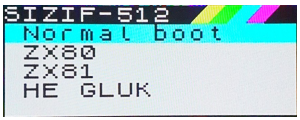
DivIDE Controller v5.7c with CF Card Adapter

DivIDE is the older brother of **DivMMC**, which introduced the ability to handle IDE standard hard disks and optical drives via the ZX Spectrum before SD cards were standardized and became popular. Today, instead of hard disks, Compact Flash cards can be used through an adapter. **DivIDE** is a parallel controller, making it faster than DivMMC, which has serial support—a significant advantage for the ZX Spectrum. In most cases, when ZX Spectrum clones have a built-in **DivMMC** controller that can be disabled, a DivIDE connected to the edge bus will work. However, an additional external DivMMC controller will no longer function.

Z-Controller (Implementation in Sizif-512) is an universal peripheral controller that allows connecting a standard PS/2 keyboard and mouse, IDE devices, and SD memory cards to the ZX Spectrum.

Experimental Modes ZX80 and ZX81

By turning on the power while holding down the **CAPS SHIFT** key, you can activate emulation modes for the **ZX80** and **ZX81** computers with various RAM combinations. These are experimental modes of the **Sizif-512** platform.



HE GLUK operates only with the **BDI-ZX** interface, the physical TR-DOS controller for **Pentagon**.

Preparing the SD Card

+3DOS

To prepare a new SD memory card for use with the microcomputer, you can configure the SD card to be simultaneously supported by the **esxDOS** operating system and the **+3BASIC** mode **+3e**. From version 1.28, **+3e** mode allows simultaneous support of the FAT16/32 file system with **+3DOS**. To achieve this, perform the following steps:

- On a PC-Class Computer remove all existing partition information on the SD card. Create a new MS-DOS partition table
- The first primary partition size (type as "not supported by PC") must occupy the area that +3DOS will use, or leave this part of the card unallocated (the **+3DOS** tools do not detect configurations made on PC and can overwrite this space, damaging it for PC access and vice versa!
- You may create FAT or other partitions in the remaining space of the SD card
- with +3DOS tools format the SD card in the space limited to the size of the first partition or the unallocated space.

When using the **.brow**se program, leave the initial part of the SD card unallocated.

Insert the SD card into the **ZX Spectrum Neo** and start it in **+3e** mode with "SD card" set to **"ZC/+3e".** Select the **+3BASIC** in the menu and enter the command

```
cat tab
```

For example, for a **32GB** card, you will receive the following output:

```
MMC unit0 (65535/2/128)
MMC unit1 (not detected)
```

The standard DivMMC/DivIDE interface allows for physical connection of two media, however, the ZX Spectrum Neo is physically equipped with only one SD card slot.

A single supported partition for +3DOS has a capacity of 1MB to 16MB, there are 26 Latin alphabet letters, which gives a space for simultaneous use of 416MB, partitions can be from 1 to 65535, but then you have to switch the letters of the alphabet. On the SD card, you will prepare the initial 504MB, dividing by 16MB gives 32 partitions for +3DOS (originally, the PC supported 504MB disks/partitions, a limitation of the computer's BIOS). In the near future, it is planned to provide a tool for +3e, which will be able to copy files between +3DOS and FAT (probably FAT16). Therefore, prepare the SD card as follows:

- 504MB as unallocated space for use by +3DOS with a safety margin so that +3DOS tools do not overwrite anything in the PC partition
- the rest of the SD card space, i.e. about 27GB for a 32GB card, as a FAT32 partition
- 504MB as a FAT16 partition (for possible copying of data between +3DOS/FAT16)

Depending on the operating system on your PC, choose your favorite disk partitioning tool. Choose the configured card and delete the partition settings that are there, preferably creating a new MS-DOS partition table. Then create two partitions: from the beginning 504MB/free space not used in the PC for +3DOS, in the middle free space as the first FAT32 partition so that at the end there is 504MB for the second FAT16 partition. Create partitions as primary. esxDOS must be saved on the first partition, because that is where the files of this system will be searched for by ZX Spectrum.

Example of calculating the parameters of a My SanDisk 64MB SD card, which supports 490 cylinders, 8 heads and 32 sectors (490/8/32) one sector is 512 bytes. We allocate 32MB for +3DOS and the second 32MB for esxDOS. 245 cylinder is half of the disk. That is: (245*8*32)-1=62719 sectors of 512Bytes

Command to format SD card for +3DOS:

```
FORMAT TO unit,maxpart#[,cyls]
```

unit – unit number (always 0 "zero" here)
maxpart# -number of the partitions supported (1-65535)
cyls - is the last cylinder to be formatted. Above can be partitioned from PC. Optional parameter, if omitted the whole card will be formatted for +3DOS

```
FORMAT TO 0,15,244
```

One less cylinder for safety as partition boundaries are assumed at the default partition points by the PC system.

Example of calculating parameters for a prepared 32GB SD card, which after reading with the cat tab command has (65535/2/128) and after multiplying for ZX +3e has 8GB. So where will be the limit cylinder for the capacity of 504MB?

504*1024*1024=528482304 bytes divided by 512 bytes gives the sector number 1032192. Then divide the number by 2 and then 128 to get the limit cylinder 4032. So, the FORMAT command will take the form:

```
FORMAT TO 0,27,4000
```

(4000*2*128)-1 = 1023999 sectors of 512 bytes = 499MB

Format the card as described to prepare it for +3DOS. You will be able to make 26 partitions (26 letters + one for storing +3DOS system data) with a capacity from 1MB to 16MB. 26*16MB = 416MB < 499MB < 504MB. Above 504MB the SD card is prepared for esxDOS and PC.

Enter command cat tab to get:

```
MMC unit0 (65535/2/128)
PLUSIDEDOS                64K systemem
~~~~~~~~~~~~~~~           499MB FREE
26 free partition enteries

MMC unit1 (not detected)
```

Now create a partition and assign it to a letter. End each line with ENTER:

```
new data „partition01”,16
move „c:” in „partition01” asn    - the parameter asn sets permanent assignment
load „c:” asn                     - sets the default drive

MMC unit0 (65535/2/128)
PLUSIDEDOS                64K systemem
partition01            16384K data C:
~~~~~~~~~~~~~~~           479MB FREE
29 free partition detected)

MMC unit1 (not detected)
```

Other Useful +3e Commands for Managing +3DOS Partitions on SD Card

```
cat or cat”c:”                    -contents of the default or specified drive
move „partition01” bin            -removes the partition
move „partition01” for „utils”    -changes the partition name
cat asn                           -shows current list of letter assignments
move „c:” in „partition01” asn    -permanently maps the partition to a letter
move „c:” out asn                 -removes the permanent mapping
```

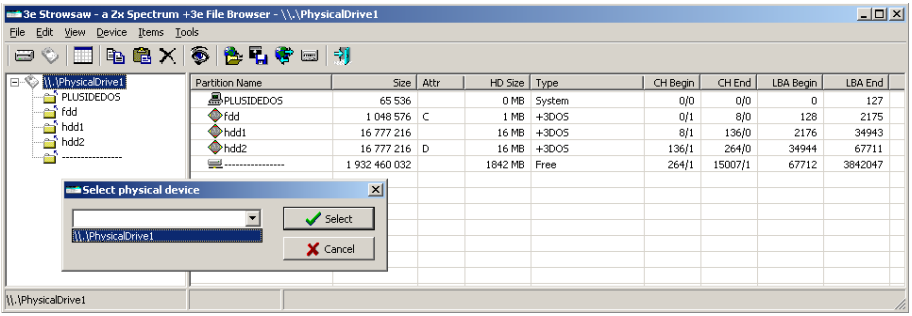
The asn parameter causes the information to be saved. When you turn off and turn on the computer, settings will be restored. If you use commands without the asn parameter, settings will not be saved after turning off the computer.

Before deleting a partition, you must remove the letter mapping. You can use letters A-P for mapping, but you can only make two mappings at a time, excluding mappings A, B, M (which correspond to two floppy disk drive stations and a RAM disk). If nothing is configured, the computer in +3e mode only starts with the mapping M:→RAM disk. When you connect the FDD controller with drive(s), the computer automatically maps additional drives A and B.

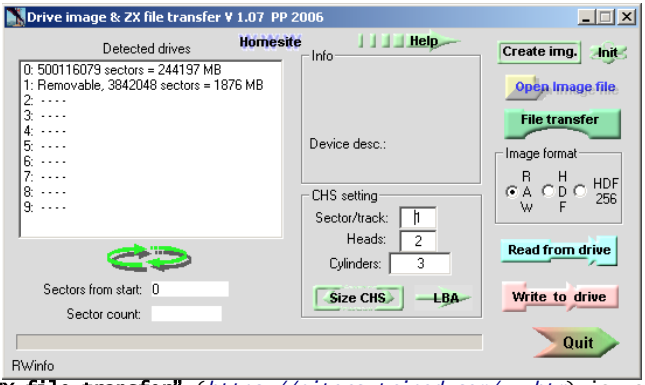
Find more details in the **ZX Spectrum +3** manual and on the website worldofspectrum.org/zxplus3e/

Several tools have been created to make managing data on **+3DOS** partitions easier. Currently, to work correctly with them, you may need access to a computer running **Windows XP** or a **Linux** system with tools that allow running Windows/DOS programs (such as **Wine** or **DOSBox**). Modern versions of Windows may have issues handling older programs.

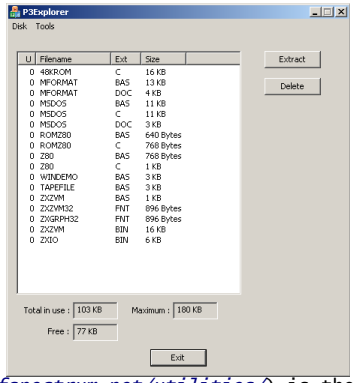
Useful tools



„3eStrowsaw" tool (*https://worldofspectrum.org/zxplus3e/transfers.html*) is a tool designed for connecting SD cards and their HDF images with the **+3DOS** file system to a PC. It allows transferring files between PC and SD (+3DOS). It does not detect cards with simultaneous **+3DOS/FAT** sharing. In such cases, to transfer data from the PC to the ZX Spectrum +3e, you must use a real FDD controller (floppy disk, Gotek)



„Drive image & ZX file transfer" (*https://piters.tripod.com/zx.htm*) is used for generating SD card images with the **+3DOS** system, as well as reading and writing them to/from the SD card.

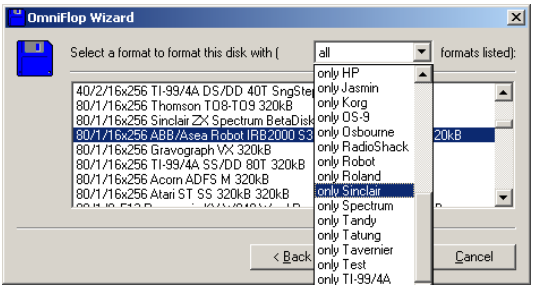


„P3Explorer" (*https://worldofspectrum.net/utilities/*) is the tool used for exploring

.dsk floppy disk images for +3 systems, generating new empty images, extracting content to a PC disk, and clearing image contents.



„CPCDiskXP" (*http://www.cpcmania.com/cpcdiskxp/cpcdiskxp.htm*) is used for operating on various floppy disk formats for CPC/IBM/PCW/+3DOS and their images in **.DSK** files.



„OmniFlop" (*http://www.shlock.co.uk/Utils/OmniFlop/OmniFlop.htm*) an format dozens of different floppy disk standards that have ever been created for computer support.

esxDOS

To create a new SD disk with the **esxDOS** system, on a PC-class computer, unzip the downloaded archive **esxdos089.zip** from the esxdos.org and copy its contents to the root directory of the first FAT32/FAT16 partition of the SD card.

The ZX Spectrum Neo already has a disk with the esxDOS system. However, according to the readme.txt file, you can perform an installation/update of esxDOS to your existing version if it is incompatible. To do this, upload and run the esxmmc.tap file, then turn off and turn on the computer again or reset it while holding the Space key to reinitialize the built-in interface.

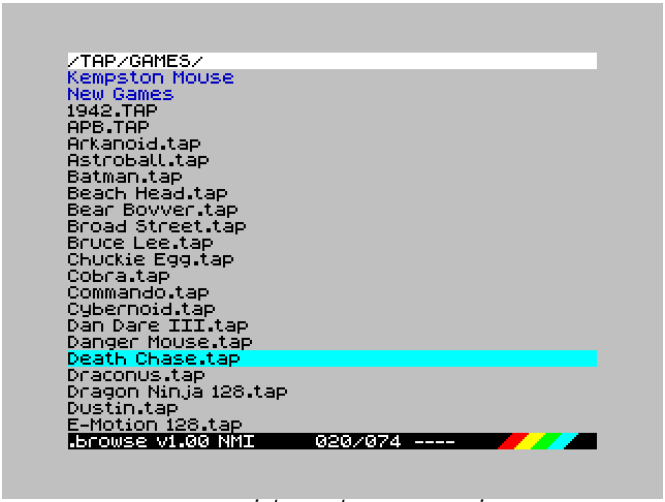
Remember to back up the original SD card archive of the ZX Spectrum Neo computer before performing these actions! It is best to install the new system on a new SD card. Otherwise, you may lose the functioning system copy.

If you do not want to use the +3e capabilities, simply format the entire SD card as FAT32 and appropriately upload the unzipped esxDOS archive.

From experience, lower-quality, non-official SD cards do not always work correctly. We recommend purchasing cards from reputable brands: Kingston, Panasonic, SanDisk.

In +3e mode to properly use esxDOS capabilities, you must select "48K ROM" as "LG" instead of "Default".

Long file names



Screen with LFN browser running

The standard file manager in the esxDOS system does not support long file names. This limitation can make file management cumbersome, especially when dealing with descriptive or lengthy file names. If you require support for long file names, you can use an alternative file manager. This alternative manager is already included on the SD card connected to the ZX Spectrum Neo. To launch it, simply enter the following command in the BASIC command line:

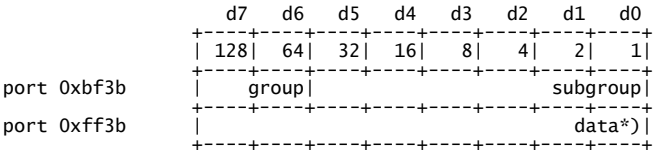
```
.browse
```

If you want to replace the default file manager with one that supports long names, then in the **\SYS\NMI_versions** folder you will find two files: **NMI_default.SYS**, and **NMI_browse.SYS**. Depending on which one you replace the original **NMI.SYS** file with in the **\SYS** folder - this browser will be the default one. Of course, you must remember to change the file name to NMI.SYS.

If you don't have an original ZX Spectrum Neo SD card and want to add long filename support, download the BROWSE_latest.zip archive from the "Long Filename Browser for ZX-UNO / esxDOS" forum at spectrumcomputing.co.uk, unzip the archive, copy the BIN and SYS folders to the SD card for esxDOS. If you want to keep the default NMI.SYS, don't copy the contents of the SYS folder, then typing the dot command `.browse` will invoke that browser), but the default file browser will still be the original one.

ULAplus™

The ULAplus™ chip is is controlled by two ports:
0xbf3b (48955) mode selection port (write)
0xff3b (65339) data port (read/write) read operations depend on the CPLD input



*) facilitates the **read/write** operations of values ranging from **0 to 255** to the **ULAplusTM** registers or modes selected via **Port 0xBF3B**

group: 00 -palette selection 0-63(subgroup) for write/read byte by the port 0xff3b
01 -mode selection, bits 0-2 selects screen mode, bits 3-5 hi-res screen color
however, Sizif does not support TIMEX modes, so in practice:
bity 0-2 = 000 screen0, screen5
bity 3-5 = 000 black on white. Other values are not supported in Sizif
10 -not implemented
11 -not implemented
data if group=00 color definition for write/read in the ULA+ registers
if group=01 bit0: ULAplus pallete (1)on/(0)off

UWAGA 1: Turning off the **ULAplus** mode does **not** restore the standard ULA palette colors. This is only caused by resetting, or restarting the computer, or loading the standard ULA color definition before turning off ULAplus mode..
UWAGA 2: The introduced ULAplus support in Sizif does not support the full specification and there may be distortions in its operation.

Example:

```
10 OUT 48955,64: OUT 65339,1: REM enabling ULAplus mode
20 REM loop loading color palette
30 FOR n=0 TO 63: OUT 48955,n
40 OUT 65339,PEEK(PAL+n): REM PAL-color palette byte address
50 NEXT n
```

Find out more about the possibilities of ULAplus™ on the website
https://zxdesign.itch.io/ulaplus

RAM organization

ZX Spectrum Neo has 512 kB of RAM, but not all of it is always available. Depending on the operating mode (parameter "Machine" in the configuration):

- **48** – 48kB RAM available – like in ZX Spectrum 48
- **128** – 128kB RAM available – like in ZX Spectrum 128/+2
- **+3e** – 128kB RAM available – like in ZX Spectrum +3
- **Pentagon** – 256kB or 512kB RAM available depending on whether SD card support is enabled.

Pentagon:
With SD card inserted (and SD support enabled):

- 128kB available in switchable memory banks by writing to port #7FFD as in ZX Spectrum 128
- 128kB available in switchable memory banks by writing to port #DFFD
- 128kB is reserved for SD card support
- 128kB unavailable for use

With SD support disabled (or SD card removed):

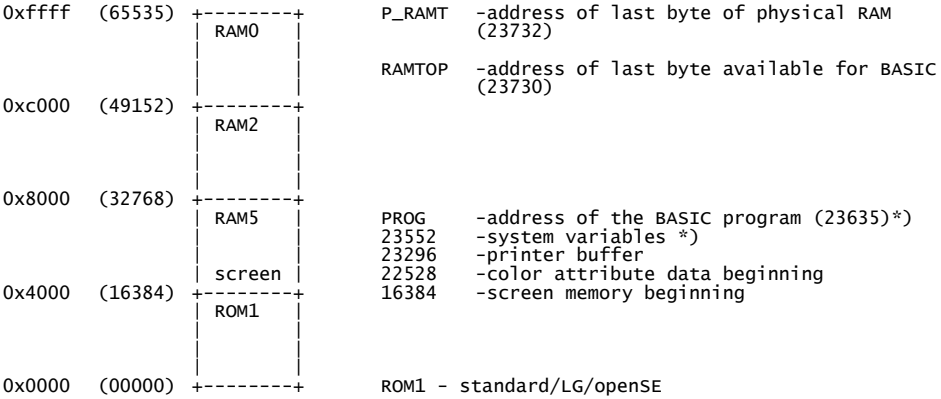
- 128kB available in switchable memory banks by writing to port #7FFD as in ZX Spectrum 128
- 384kB available in switchable memory banks by writing to port #DFFD

Note 1: ULAplus and MAGIC key menus use one memory page (16kB) of the 384kB area. For this reason, it is not recommended to use ULAplus and MAGIC when running applications that use the full 512kB.

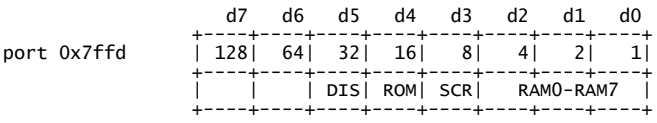
Note 2: Port #DFFD and memory above 128kB is only available in Pentagon mode.

Note 3: ROM/RAM bank/page size is 16kB

ZX Spectrum 48k memory layout



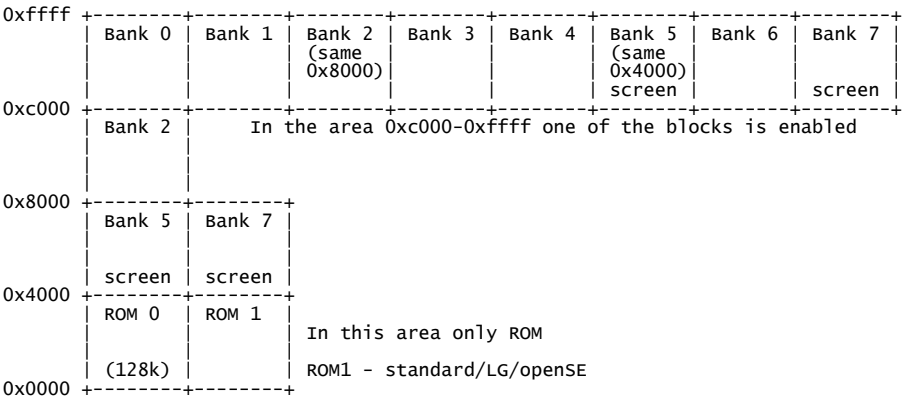
ZX Spectrum 128/+2 memory layout



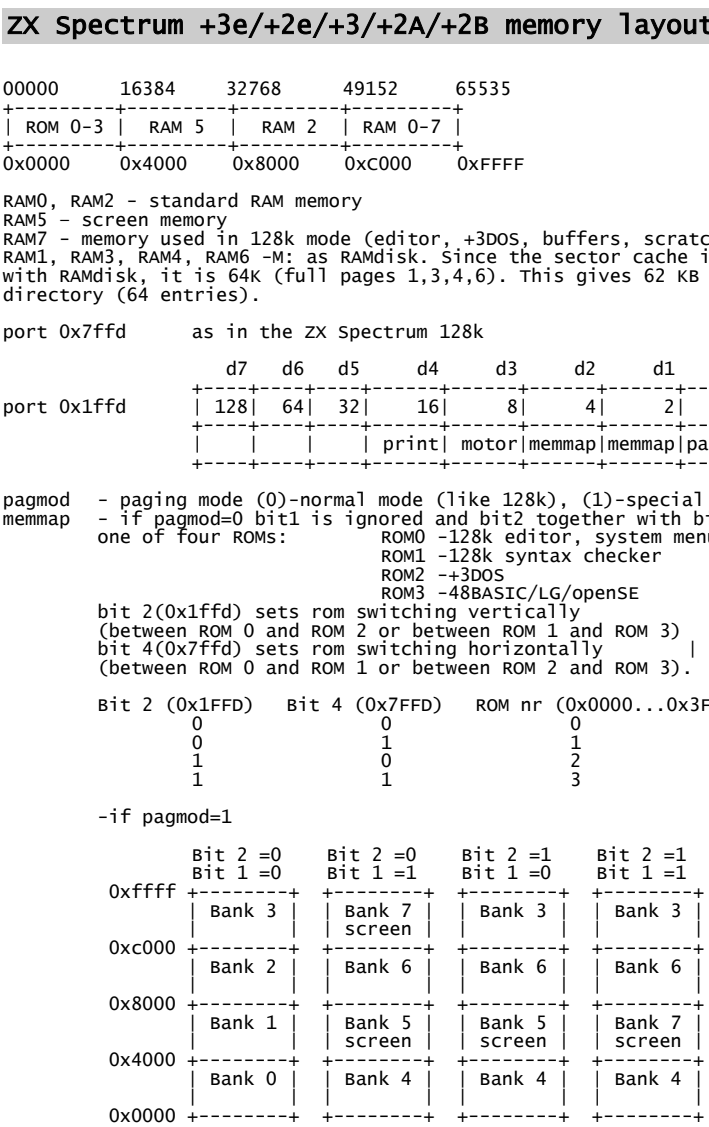
DIS-(1) blocking port 0x7ffd until reset, computer works like zx48k.
Switching from 128BASIC to 48BASIC mode with unlocking this port only by the "randomize usr 0" command, then ROM48 has access to the entire 128kB memory
The "spectrum" command from 128 BASIC or selecting 48 BASIC mode from the menu blocks this port by setting bit d5=1, while in 128BASIC mode bit d5=0
ROM-(0) selecting ROM128, (1) selecting ROM48 (set-up by system itself),
SCR-(0) bank5 as screen, (1) bank7 as screen, with BASIC messages still sent to bank5
bits d0, d1, d2 selects memory bank to be mapped to 0xc000.

Example:

```
OUT 32765,16+2   -connecting bank2 with ROM48 enabled
OUT 32765,16+8   -display second screen (bank7)
OUT 32765,16     -restore bank0 and bank5 screen
```



ZX Spectrum +3e/+2e/+3/+2A/+2B memory layout



RAM0, RAM2 - standard RAM memory
RAM5 - screen memory
RAM7 - memory used in 128k mode (editor, +3DOS, buffers, scratchpads)
RAM1, RAM3, RAM4, RAM6 -M: as RAMdisk. Since the sector cache is not required for use with RAMdisk, it is 64K (full pages 1,3,4,6). This gives 62 KB of data and 2 KB of directory (64 entries).

port 0x7ffd as in the ZX Spectrum 128k

pagmod - paging mode (0)-normal mode (like 128k), (1)-special mode
memmap - if pagmod=0 bit1 is ignored and bit2 together with bit4(0x7ffd) selects one of four ROMs:
ROM0 -128k editor, system menu and selftest
ROM1 -128k syntax checker
ROM2 -+3DOS
ROM3 -48BASIC/LG/openSE

bit 2(0x1ffd) sets rom switching vertically (between ROM 0 and ROM 2 or between ROM 1 and ROM 3)
bit 4(0x7ffd) sets rom switching horizontally (between ROM 0 and ROM 1 or between ROM 2 and ROM 3).

Bit 2 (0x1FFD)	Bit 4 (0x7FFD)	ROM nr (0x0000...0x3FFF)
0	0	0
0	1	1
1	0	2
1	1	3

-if pagmod=1

motor -Disk motor; 1=on, 0=off
print -Printer port strobe

Pentagon(Profi) 512k memory layout

```
                          d7   d6   d5    d4   d3   d2   d1   d0
                         +----+----+----+-----+----+----+----+----+
                         | 128|  64|  32|   16|   8|   4|   2|   1|
                         +----+----+----+-----+----+----+----+----+
port 0x7ffd (32765)      |    |    | DIS|  ROM| SCR|     RAM      |
                         +----+----+----+-----+----+----+----+----+
port 0xdffd (57341)      |~~80DS~~|~~SCR~~|CP/M|NOROM| SCO|     RAM      |
                         +----+----+----+-----+----+----+----+----+
                                                |  ~~32~~|  16|   8|
                                                +----+----+----+----+

0x7ffd (d2,d1,d0)  000  001  010  011  100  101  110  111          0xdffd (d2,d1,d0)
                  +----+----+----+----+----+----+----+----+
                  |24  |25  |26  |27  |28  |29  |30  |31  | 512k     011
                  +----+----+----+----+----+----+----+----+
                  |16  |17  |18  |19  |20  |21  |22  |23  | 384k     010
                  +----+----+----+----+----+----+----+----+
                  |08  |09  |10  |11  |12  |13  |14  |15  | 256k     001
         0xfff    +----+----+----+----+----+----+----+----+
                  |00  |01  |02  |03  |04  |05e |06e'|07e | 128k     000
         0xc000   +----+----+----+----+----+----+----+----+
                  |02  |06e'|
         0x8000   +----+----+
                  |05e |07e | e -screen
         0x4000   +----+----+
                  |ROMs|
         0x0000   +----+
```

port 0x7ffd as in ZX Spectrum 128k
port 0xdffd

- RAM -selection of one of the RAM00-31 memory banks together with RAM (0x7ffd) (bit d2 is ignored because Sizif has only 512kB RAM)
- SCO -selection of the RAM00-31 bank connection window. (0)-0xc000, (1)-0x4000
- NOROM -(1) disables port 0x7ffd lock and disables ROM by placing RAM00 in 0x0000
- CP/M -(1) blocks TR-DOS controller operation at the ROM level, (?) when d4=0 (0x7ffd) allows access to controller ports from RAM, when d4=1 (0x7ffd) modifies access to extended memory
- SCR displays an additional RAM06 screen on the processor memory card instead of RAM02, where bit d3 (0x7ffd) must be set to (1) (0x8000-0xBFFF) (?)
- 80DS -(0) video controller RAM05, -(1) extended video controller (RAM06 i RAM58)- not available in Sizif

When an SD card is inserted and the divMMC or ZC/+3e card support mode is enabled, then the d1 bit (0xdffd) is ignored for the user and 265kB of memory from RAM banks 00-15 selected by bit d0 are available. Of the other half, 512kB, 128kB are used to support the SD card. The rest of the RAM is unused.

Examples:

```
CLEAR 49151: OUT 57341,2: OUT 32765,16+6: REM BANK RAM22
                  16       +        6        =        22

10 CLEAR 49151
20 LOAD *"OTHER.ROM" CODE 49152
30 OUT 32765,16+1: REM switching to RAM01 bank while maintaining 48ROM
40 OUT 57341,16: REM Turning on OTHER.ROM loaded into RAM00
```

Note!
When connecting your computer's RAM00 -> 0x0000-0x3999 support, you must write your own interrupt support.

List of verified external interfaces

Below is a list of tested interfaces according to the author of the Sizif-512 project (motherboard of the ZX Spectrum Neo computer).

[1] Used and tested by the author of this manual.
[2] Not on the GitHub list but tested by the author of this manual.

- **AYX-32**
- **BDI-ZX ver 2.0 MVcomp FDD interface,** a controller for floppy disk drive stations supported by the TR-DOS standard. It frees the entire 512kB of RAM.
- **ZX Dandanator! Mini 2.1** [1] This is a hardware external peripheral EEPROM memory intended to be a platform for developing and releasing games, as well as serving as a loader for Z80/SNA/TAP/ROM game snapshots. You can also add "pokes".
  The working version blocks the operation of Magic and SD.
- **ZX DandaCart** [2] Similar to the above, but the EEPROM memory is placed in removable cartridges (compatible with Dandanator Mini). The working version blocks the operation of Magic and SD.
- **ZX TSid** [1] An extension that allows the Pentagon and ZX Spectrum 128 to play original Commodore C64 sound files. It does not work with the original SID unless additional voltages are provided on the edge bus (see TSid configuration description on its PCB).
  Caution: If you make a mistake with voltages and use the wrong power supply, you can burn the original SID chip.
- **Multiface 128 1.00 by Steve Smith,** This interface can freeze a program, save it in various formats (Tape, Microdrive, Disk, etc.), and add "pokes" (changing RAM values), e.g., for infinite lives in games.
- **+3DOS floppy controller** [1] An external floppy disk drive controller for the ZX Spectrum +3 microcomputer. With Sizif, it operates in +3e mode.
- **PLUS 2A FDD Interface** An external floppy disk drive controller for the ZX Spectrum +3 microcomputer. With Sizif, it operates in +3e mod.
- **DivIDE 5.7d** (Sizif without SD card) A controller for handling IDE standard hard disks and optical drives.
- **DivIDE 5.7c** (Sizif without SD card) [1] When an SD card is present, its blocked. This controller handles IDE standard hard disks and optical drives, blocks the operation of Magic, and frees the entire 512kB of RAM (probably also in other versions).
- **DMA 2.02 by ShamaZX** Direct memory access controller.
- **Kempston + TurboSound interface** is an interface combining two functions: a sound card and a joystick interface.
- **ZX-HD** [1] An HDMI interface with external ULAplusTM support. Some demos may not display correctly due to potential timing mismatches with HDMI.
- **ZX-VGA-JOY** ZX Spectrum interface for connecting various VGA monitors and a Kempston joystick. It is not a signal converter but operates in parallel with the internal IC graphics (ULA) generating video data. During operation, it accesses the screen memory and retrieves image data to display.
- **Spectranet by ByteDelight** [1] An interface providing internet support via LAN, connecting the ZX Spectrum to TNFS servers. It blocks reset/Magic and the operation of Magic, and additionally, other connected interfaces block the loading of TAP files to memory.
- **ZXKit1 VGA converter**. An addition to the EGA monitor connector, a scandoubler for ZX Spectrum
- **K-mouse TURBO 2017** [2] An interface providing support for various joystick standards (Kempston, Sinclair, mapping QAOPM space keys) and a Kempston mouse. It has a master/slave mode for two devices. Depending on the interface's working mode, you need to set the joystick mode in the Magic menu so that the Sizif and K-mouse interfaces do not block each other.

When an interface blocks the **Magic button** the ZX Spectrum Neo operates in Pentagon mode with all factory settings, even if a different hardware startup configuration was saved in the Magic menu under **Advanced.../Save** settings.
Future firmware versions may change this state..

Thanks to the edge bus output from the back of the computer, you can connect various add-ons that expand hardware capabilities, compatible with the ZX Spectrum edge bus. The ZX Spectrum Neo, unlike original ZX Spectrum versions, only has **+5V voltage** on the edge bus output. Most expansion cards use only +5V, but older 1980s models may require additional, missing voltages: **+9V** and **+12V**.

Be careful with power supply polarity!
The ZX Spectrum Neo accepts any polarity of power supplies: **plus in the middle** (standardly) or **plus on the outside** (atypical standard used in original 1980s ZX Spectrum). If only **+5V** is required for expansion cards, power supply polarity can be arbitrary.

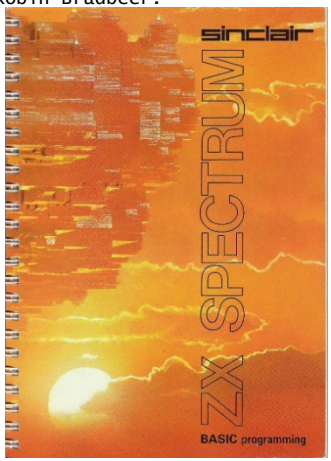
It is possible to directly output additional voltages **+9V** or **+12V** on appropriate pins of the computer's edge bus depending on the power supply used. Then you can use the appropriate jumper or voltage converter on connector **J3** next to the power socket according to the description, leaving the appropriate marking. **You must ensure correct power supply polarity, i.e., plus on the outside** (as in 1980s models)!

ZX Spectrum computers comparition

	48/+	128/+2	+3/+2A/+2B	Neo
RAM available	48kB	128kB	128kB	512kB
ROM available	16kB	32kB	64kB	512kB
DOS	-	-	+3DOS	esxDOS/+3DOS
Joysticks	-	2	2	1
Data storage	Cassette option: ZX Microdrive, disk drive	Cassette option: ZX Microdrive, Disk drive	Disk drive or cassette	Cassette SD card option: bluetooth, disk drive
Sound	„beeper”	3-channel chip AY-3-8912	3-channel chip AY-3-8912	3-channel chip AY-3-8912, covox mono, SounDrive (4-channel covox) Option: additional sound card: TurboSoundFM, GeneralSound (12MHz/512kB RAM), SAA1099, MIDI
Video output	RF (antenna)	composite, RGB	RGB	composite, RGB
RS-232/MIDI	-/-	+/+	+/+	+(TTL)/(?)
Graphics	256x192px 15 colors	256x192px 15 colors	256x192px 15 colors	256x192px 15 colors ULAplus™: 256x192px 64 colors from the palette of z 256
GPIO ports	-	-	-	8 I/O ports

Recommended literature and links

To learn more about programming in the BASIC language, refer to more comprehensive literature. I especially recommend the original, published alongside the historic ZX Spectrum, excellent textbook **"ZX Spectrum BASIC Programming – 3rd Edition"** by Penny Vickers, Steven Vickers, and Robin Bradbeer.



The list of available 'dot commands' can be supplemented with additional programs downloaded from the Internet. New subprograms are appearing worldwide, and you can find their relatively comprehensive list at the links below:

https://docs.google.com/spreadsheets/d/17-ifpHcy932_AP7SAv9uBLxg-2ZptcdgTvQ8ILXQLM4/htmlview

Other links:

https://speccy.info/Z-Controller – Notatka na temat Z-Controller

https://worldofspectrum.net/item/2000438/ – ZX Spectrum BASIC Programming Book

https://worldofspectrum.org/zxplus3e – All about the +3e

https://worldofspectrum.org/ZXSpectrum1283Manual – The ZX Spectrum +3 manual

https://worldofspectrum.org/tools/utilities – Tapir1.0 download page

esxdos.org – esxDOS System homepage

https://zxdesign.itch.io/ulaplus – The official webpage of the ULAplus™

https://github.com/UzixLS/zx-sizif-512 – Github for the ZX Sizif 512

https://worldofspectrum.org/zxplus3e/transfers.html – 3e + 3e Strow Saw

https://piters.tripod.com/zx.htm – Drive image & ZX file transfer

https://worldofspectrum.net/utilities/ – P3Explorer download page

http://www.cpcmania.com/cpcdiskxp/cpcdiskxp.htm – CPCDiskXP

http://www.shlock.co.uk/Utils/OmniFlop/OmniFlop.htm – Floppy Disk Tansfer: OmniFlop

https://octocom.speccy.org/workbench_en.html – Windows oriented operating system WORKBENCH +3e



ZX Spectrum Neo

295 EUR

A modern replica of an iconic computer

The ZX Spectrum 48, which debuted in 1982, was one of the first popular 8-bit computers, providing a platform for thousands of games and programs.
However, those computers can be problematic to use today. They require old TVs, games must be installed from a tape recorder, needs external joystick interface. Many of the 40-year-old computers need restoration or repair before use.

The ZX Spectrum Neo is a modern replica of this iconic computer, devoid of the above inconveniences.
We have added more RAM memory, Bluetooth instead of a tape recorder, SD card instead of floppy disks. ZX Spectrum Neo can be expanded with a WiFi module, sound card and external PS/2 keyboard. It also has an edge connector to connect accessories of the original ZX Spectrum: disk drives, printers, microdrives, RS-232 serial, RTC clock, GPIO ports and much more. ZX Spectrum Neo can work in ZX Spectrum 48, 128, +2, +3, ZX80, ZX81 and Pentagon mode.

Includes:

- Computer in "rubber case"
- Joystick (Kempston)
- Monitor cables (SCART/RCA)
- SD card with esxDOS
- SD/USB card reader
- Bluetooth module
- User manual (52 pages)
- Power supply with power switch

Technical data:

- esxDOS operating system
- 512 kB RAM, 512 kB ROM
- Real Z80 and AY-3-8910 chip
- ZX EDGE CONNECTOR port
- RGB, composite and stereo sound ports
- Kempston and Sinclair joystick port
- GPIO and EGA ports

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Sizif-512

Modern ZX Spectrum clone DIY kit

PCB + CPLD + ROM - 33 EUR
PCB + set of elements - 92 EUR
PCB + elements + housing - 150 EUR

Sizif-512 is the motherboard of the ZX Spectrum Neo computer. It is an extended version of the Harlequin 128 project with SD card support, esxDOS operating system, switchable ROM banks of different ZX Spectrum versions: ZX80, ZX81, 48, 128, +2, +3, Pentagon, as well as two diagnostic programs.

Sizif-512 is a self-assembly kit in which the most difficult electronic components, such as CPLD and some integrated circuits, are already soldered and programmed. Thanks to this, we have reduced the level of difficulty required for its assembly. You also do not need special programmers for CPLD and ROM.

The full kit includes:

- PCB board and full set of components
- Assembly manual
- Soldered and programmed CPLD and ROM
- SD card with esxDOS system, demos and music
- ZX Spectrum 48 case with keyboard

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