

In the 'GO TO (1E67)' command routine the line number is tested against an upper value of 61439 which should be 10000 as only lines 0-9999 can be entered in the BASIC system. At the end of the 'Scanning SCREEN\$ subroutine' there is a JUMP to STK-STO-\$ (2AB2) which leads to double storing of the string result. This instruction should be a RET.

The instruction line at L-DELETE\$ (2B72) is LD HL,(DEST) which is redundant. There should have been an extra instruction after the RST 28 (FP-CALC) instruction at (2E25). This extra instruction is DEFB 2 (delete). Without it, the stack becomes unbalanced. An expression like PRINT "2" + STR\$ 0.5 is evaluated incorrectly as 0.5; the zero left on the stack displaces the "2" and is treated as a null string.

In the 'Division operation' routine there is a JR Z to DIV-START(31E2) which should be to DIV-34TH (31DB). No 34th bit will ever be obtained without first shifting the dividend. Hence important results like 1/100 and 1/1000 are not rounded up as they should be. Rounding up never occurs when it depends on the 34th bit. The 'USR function (34B3)' routine doesn't cater for a successful routine to BASIC as HL' must contain 10072 (2758). This holds the next literal pointer and is not restored should it have been disturbed by machine code.

The ZX Spectrum 48k ROM does not always handle the number -65536 correctly. This value is sometimes put in 'short' form and at other times in 'floating point' and this leads to trouble.

The 'Addition operation (3014)' routine can't add two smaller negative integers like -65000 + -536 and it's printed as -1E-38 obtained by treating it as -0 in an illegitimate format. At 3032 there should be a test for this number and, if it's present, produce the five byte floating-point form of this number: 91,80,0,0,0 (hex) which causes no problems.

The five bytes at 30E5 in the 'Multiplication operation' routine can be removed if the number -65536 (0,255,0,0,0) is excluded from the system. The 28 bytes from 3223 to 323E inclusive should be removed too, as the 'Integer truncation towards zero (3214)' subroutine can't handle the number -65536 resulting in returning the value -1 after a INT (-65536).

#### *Memory map of ZX48 Emulator:*

Page 1: emulator code	Page 5: 16k RAM
Page 2: buffer/stack space	Page 6: 16k RAM
Page 3: 16k ROM (patched)	(Remaining pages: used for loading/ saving of programs.)
Page 4: 16k RAM	

# Welcome to

# ZX SPECTRUM 48k

# Emulator v3.3

(For use with SAM Coupé)



## Welcolme to ZX SPECTRUM 48k Emulator v3.3 readme file.

### ZX SPECTRUM 48k Emulator v1.1 - v3.3 is (c) Martijn Groen 1999.

Many thanks & credits to Edwin Blink for tips, ideas and parts of B-DOS source code. Also many credits go to Robert van der Veeke for lending me his ZX Spectrum ROM disassembly book. And infinite credits go to Dr. Ian Logan & Dr. Frank O'Hara for disassembling the ZX SPECTRUM 48k ROM. Additional credits go to James McKay (x128), Gerton Luntor (Z80), Rui Ribeiro (WSpecEm) and others for designing the .SLT format and for placing lots of technical information on the internet.

#### **System requirements:**

- \* B-DOS v1.5a or higher
- \* Z80B 6 Mhz processor or higher recommended
- \* 256 KB RAM required
- \* Harddisk with at least 1 available record
- \* DALLAS & SAMBUS-clock supported
- \* Optional: 3-way joystick splitter (from Edwin Blink!) for Kempston joystick emulation.
- \* Optional: Atapi CD-ROM drive, printer

This Emulator was basically written for game playing. Spectrum programs which were specifically written for special hardware, such as Disciple/+D won't work as they should do.

#### **Supported fileformats:**

*Normal programs:* standard tape & Disciple/+D programs. *TAP filelessnaps:* Snapshot 48k, SNA, SP, LERM3 files & Z80 (v1-v3.0x). Level loaders: Disciple/+D using hookcodes, TAP & SLT files.

This Emulator supports standard 48k SP files, which come from Spanish Spectrum emulator by Pedro Gimeno and not the ones that come from VGASpec emulator which is the illegal prerelease of the Spanish Spectrum emulator.

#### *Supported file types on SAM disk/record:*

Disciple, Plus D, Basic programs, Data/String arrays, Code files, Screen\$ files & Snapshots 48k. Many Disciple & +D multi-loaders are also supported (hookcodes). Files saved by this emulator can be read by Disciple/+D again.

#### *K Invalid colour*

The value specified for INK, PAPER, FLASH, BRIGHT, INVERSE or OVER or the corresponding control characters is out of range.

#### *L BREAK into program*

BREAK was pressed. The report specifies the last statement to be executed and CONTINUE resumes at the next statement.

#### *M RAMTOP no good*

The value specified for RAMTOP is either too big or too small.

#### *N Statement lost*

A jump has been attempted to a statement that no longer exists.

#### *O Invalid stream*

An attempt to open a stream greater than 15 was made.

#### *P FN without DEF*

An FN statement has been used without the corresponding DEF FN statement.

#### *Q Parameter error*

An FN statement contains the wrong number of values to be passed to the function, or one of the values is the wrong type.

#### *R File loading error \**

The file could not be handled by the command or a bad sector on (hard)disk was found.

#### **Some ZX Speccy ROM bugs fixed:**

In the 'Cursor left' subroutine, the line number is tested against an upper value of 24 which should be 25. The last instruction of the 'Cursor right' subroutine is a RET, which should be JP PO-STORE (0ADC). The first instruction of the 'Print comma' subroutine is CALL PO-FETCH (0B0C) which is redundant.

In the 'Test for scroll' subroutine there is a CALL to WAIT-KEY (15D4). However, the WAIT-KEY subroutine doesn't handle some control codes properly meaning garbage will appear on screen if you use the Capslock or Graphics code for example, if you want to scroll further. At the end of the 'Close stream look-up table (1716)' there is no end-marker. So, an instruction like CLOSE #0 could cause the system to crash.

#### *9 STOP statement*

STOP has been used to halt the program. CONTINUE will resume at the next statement.

#### *A Invalid argument*

A function has been given a wrong argument or value.

#### *B Integer out of range*

A value has been rounded to the nearest integer and is out of the range that can be accepted.

#### *C Nonsense in BASIC*

The text of the (string) argument does not form a valid expression.

#### *D BREAK - CONT repeats*

BREAK has been pressed. CONTINUE will repeat the statement at which the computer stopped.

#### *E Out of DATA*

READ has tried to read beyond the end of the final DATA statement in the program.

#### *F Invalid file name*

SAVE, LOAD, VERIFY, MERGE, ERASE or OPEN has been used with a name containing more than 10 characters or no name was specified or a stream other than channel K, S or P was opened.

#### *G No room for line*

There is not enough memory left to enter the new program line.

#### *H STOP in INPUT*

STOP has been entered in response to INPUT or began the data entered. CONTINUE repeats the INPUT statement.

#### *I FOR without NEXT*

A FOR NEXT loop has not been carried out because the limits or STEP value were wrong (for example, FOR x=5 TO 0 without STEP) and the corresponding NEXT has not been found.

#### *J File was not found \**

The file specified after a MERGE, LOAD, VERIFY, ERASE or OPEN was not found on the current B-DOS/MS-DOS record or CD-ROM.

#### *SAM CODE:*

file.SNA, file.SP, file.LRM, file.TAP & file.Z80/SLT. If you want to use SLT (super level loader trap) files on SAM disk/record you have to rename them first to

"xxxxxxx.Z"

TAP files: "xxxxxxx.T",

SNA or SP files: "xxxxxxx.S"

#### *MS-DOS disk/record and CD-ROM/CD-R:*

file.SNA, file.SP, file.TAP, file.SCR, file.Z80 & file.SLT

You don't have to rename SLT files to Z80 files when you are using MS-DOS disks/records, but even if you do so, the Emulator automatically checks whether a Z80 file contains SLT data or not. Also, you can rename SP files to SNA files and vice versa.

#### *\* Warning \**

Always use RUN or F4 to return to the Emulator if you are in SAM Basic. Although the Emulator will work with RECORD 0, it is recommended that you copy your Spectrum files to harddisk. If you have any problems running the ZX48 Emulator, try installing the latest Direct ZX drivers.

I have found out that the PLUS-D version of PAW (A16D) is fully compatible with my Emulator, except you can't switch drives, using the 'Y' option. Instead press F5 or F6 to go back one record or advance one record or ESCape to BASIC, select a record and return to the Emulator again. With some games it's possible to Escape to BASIC, insert a few pokes and then return. However, a few games could crash by doing so. If a game does crash, try the following next time: type RUN, press Return but don't release it. Now hold down TAB key and then release Return key. This will select interrupt mode 1 instead of mode 2 at start up. You must use this procedure with: SABOTEUR 2 and BOMB JACK (found out myself). This will actually turn off the music played in BOOTY!!!

#### **Keys inside Emulator:**

You may use the - / + \* = \_ " ; : , . Delete, Edit and Cursor keys like in SAM BASIC.

- \* Control key = Extended mode
- \* Inverse key = Graphics mode (Keys A-U for UDG)
- \* Capslock key = Capitals mode
- \* Escape key = SAM BASIC (F4 returns to the Emulator)
- \* Control - gives VAL\$
- \* Control Shift - gives FLASH
- \* Control + gives SCREEN\$

- \* Control Shift + gives BRIGHT
- \* Control = gives ATTR
- \* Control Shift = gives RECORD
- \* Control " gives (C)
- \* Control ; gives OUT
- \* Control : gives BEEP
- \* Control , gives OVER
- \* Control . gives INVERSE

NMI: system reset

F0 key: reset system

F1 key: help screen

F2 key: inverse palette

F3 key: normal palette

F4 key: close TAP file, select Disciple/+D/SP/SNA/LRM/Z80 files

F5 key: go back one record (record 0 - 1 = max.record)

F6 key: advance one record (max.record + 1 = record 0)

F7 key: puts the harddisk in stand-by mode

F8 key: close CD-ROM drive tray

F9 key: open CD-ROM drive tray

As the help screen is not present in memory, it will be loaded from the Emulator's startup record. If the 'ZX HELP' file is not present on that record, you won't see much of it...

Function key F4 only applies to floppy & harddrive mode. Notice that the ESC & F1-F9 functions only work when the system is in Interrupt MODE 1 and interrupts are enabled. Do not press the F4-F9 function keys while playing games. A record can be selected by RECORD followed by the number. Use Extended mode (CNTRL) followed by SYMBOL key 0.

A directory can be displayed by DIR (names only) or DIR 1/DIR 2 (extended dir). Use Extended mode followed by SYMBOL 9. A string expression may be used after DIR1/DIR2, such as DIR 2"MG\*". If a MS-DOS disk/record is detected, the Emulator will always show the extended MS-DOS directory. You cannot enter subdirectories. Also, DIR \* or DIR "\*"name\*" may be used to display the extended directory of the current drive.

*Loading files from MS-DOS disk/record:*

Use OPEN "filename.ext" or OPEN "filename\*" to load a file from MS-DOS disk/record. The Emulator only accepts SNA/SP/TAP/Z80/SLT/SCR files. Notice that .SCR files are always loaded at address 16384 and the length of these files (TAP/SLT files too) are not checked.

HCFSM 38h = close file sector map

HGFLE 3Bh = get file from disk, IX points to start of UFIA

HLBYT 3Ch = load byte in A

HLDBK 3Dh = load BC bytes to address DE

HRSAD 3Fh = read track,sector DE at address HL

***Spectrum screen/error reports (\* = new report):***

*0 OK*

Successful completion, or an attempt to jump to a line number greater than any in the program. CONTINUE disregards this report and resumes at the statement specified in the previous report.

*1 NEXT without FOR*

NEXT has been encountered without a corresponding FOR and a variable exists with the same name as the control variable.

*2 Variable not found*

A simple variable has been used without assigning it a value or loading the value from (hard)disk, or a control variable has been used with NEXT without first setting it up in a FOR statement, or a subscripted variable has been used before dimensioning the array with DIM or loading an array from disk.

*3 Subscript wrong*

A subscript is beyond the dimensions of the array.

*4 Out of memory*

There is not enough memory space left to complete the statement or command.

*5 Out of screen*

INPUT has generated more than 23 lines in the lower part of the screen, or a line number of 22 or more has been used with PRINT AT.

*6 Number too big*

The computer has tried to produce a number greater than about 10<sup>38</sup>.

*7 RETURN without GOSUB*

The number of RETURN statements is one greater than the number of GOSUB statements.

*8 Insert disk \**

There is no disk inserted in the floppy disk drive.

have to read the Root directory first: DIR 2"/" OR DIR 2"\ (or DIR 1 etc.) Use this command until the Root directory shows up.

DIR 2"dirname" - enters & displays new directory.  
DIR 2"." - enters & displays previous directory.  
DIR or DIR 1-2 - displays current directory.  
DIR 3"name\*" - displays names & dirs using wildcards.

Use OPEN "filename" (not LOAD, sorry) to load a TAP/SNA/SP/Z80/SLT/SCR file from CD (more than 10 chars may be used). After a TAP file has been loaded you may use DIR 4 to view the contents of the TAP file. To access the harddrive again, select a RECORD other than the unique CD-ROM drive RECORD. Saving TAP/Z80 files from CD-ROM to harddrive: write down the length of the file you wish to save. To save a TAP file, just load it, select a harddrive RECORD, ESCape to SAM BASIC and save it with SAVE "name .T"CODE 131081,length.

Z80 files: load it, after the program has started, reset the Emulator using NMI. Now select a harddrive RECORD, ESCape to SAM BASIC and save it with SAVE "name .Z"CODE 131081,length.

### **ZX Line printer emulation:**

the LPRINT, LLIST & COPY commands are fully supported. Make sure your printer is turned on and is online before you started the Emulator for the first time. You may poke your own printer control codes in the Emulator code: Reset your SAM, type CLEAR 32767 followed by LOAD "ZX CODE"CODE and POKE adres 32833 with: A,x,x,x etc. A is the number of control codes and the x's are the control codes. Up to 32 bytes can be poked and the first byte being the nr. of control code bytes. After the POKES save it with SAVE "ZX CODE" CODE 32768,16384.

The standard control codes (adres 32833 holds 11) are:

27, 108, 10 - sets left margin at 10  
27, 51, 24 - sets 24/180-inch line spacing  
27, 42, 4, 0, 1 - select CRT screen

Notice that a 8-pin graphics mode must be selected and the two bytes after the graphics control code must be 0 and 1.

Disciple/Plus-D Hookcodes supported:

HOFLE 35h = open file, IX points to start of complete UFIA  
HSBYT 36h = save byte in A  
HSVBK 37h = save BC bytes from adres DE

### **Loading files from SAM disk/record:**

TAP files: To load a TAP file, it must be OPENed first (Extended mode, SYMBOL 6). Example: OPEN "BATMAN\*" and then LOAD "". Maximum TAP file lengths: 360439 bytes on 512k machines and 98295 bytes on 256k machines. DIR 3/4 can be used to view the contents of a TAP file. Use DIR 4 in CD-ROM drive mode, otherwise use DIR 3. It's now possible to LOAD any of the files in the TAP file. Make sure you supply the correct filename (upper and lower case letters!), otherwise the Emulator will just continue to keep searching for the next file, just like the original tape system! You may press 'TAB' to exit this never-ending-loop.

### **Loading speed:**

Escape to BASIC, so you can change the value after the POKE adres in LINE 50 (0-255, 1=fastest, 0=slowest). Disciple/+D/SNA/SP/LRM/Z80 files: press F4 to close any open TAP file. Also, LOAD nr. sets the Emulator to this default mode. DIR 3/4 will display an extended directory of current drive now. Only files with one of the following directory types are shown:

- 1: Basic file
- 2: Data array
- 3: String array
- 4: Code file
- 5: Snapshot 48k
- 7: Screen\$ file
- 19: SNA, SP, LRM, TAP & Z80/SLT

Some games try to read the Kempston or Fuller joystick port, however this will often cause unexpected movement. It is sometimes possible to remove this 'IN' by holding down 'SHIFT' key during loading of a game. You must hold the SHIFT key down until the game starts. This Kempston 'IN' is by default patched to read the third joystick port. This extremely handy for the Ultimate games which only have keyboard and Kempston support.

Kempston joystick emulation should work fine with most Ultimate games, Codemasters games (Dizzy, Dizzy 2), Boulderdash games and many other games. Notice that this Kempston patch, smashes BC' &AF', so if a game crashes, this patch will be the reason.

If you don't want Kempston emulation, Escape to SAM BASIC, Edit LINE 54 and change the value after the poke adres to:

- 0: disable Kempston joystick emulation
- 1: enable Kempston joystick emulation using the first joystick
- 2: enable Kempston joystick emulation using the third joystick.

Although Kempston emulation is possible using the first joystick it is recommended you use a 3-way joystick splitter and use the third joystick, because if the first one

is used, it may give problems with Interface II joystick. Also, the third joystick is read by port not used in Spectrum games, so you can happily use Kempston and Sinclair I/II together.

Use the SYMBOL key in the same way to remove the following instructions: OUT (C),A; OUT (C),D; OUT (C),E; OUTD; OUTI; OUT (C),H; OUT (C),L & OUT (253),A. Some 48k Speccy games also contain 128k paging code & 128k musicplayers which will cause unwanted interrupts, resulting in game crashes or garbade on the screen.

After a SNAP/LRM/SNA/SP/Z80/SLT has been loaded the border will change and waits for one of the following keys to be pressed:

SPACE: return to SAM BASIC. This allows you to insert a few pokes or hack a game using a disassembler. Notice that variable 'a' has been predefined as address 65536, so you can use POKE a+poke address,value. RUN or F4 returns to the loaded snapshot.

- 1: search IN A,(31) (Kempston) & replace it with RST 8, DEFB 250 or LD A,0 depending on the setting in SAM BASIC LINE 54
  - 2: search IN A,(127) (Fuller) & replace it with LD A,255
  - 3: search OUT (253),A & replace it with NOP,NOP
  - 4: search OUT (C),A & replace it with NOP,NOP
  - 5: search OUT (C),D & replace it with NOP,NOP
  - 6: search OUT (C),E & replace it with NOP,NOP
  - 7: search OUT (C),H & replace it with NOP,NOP
  - 8: search OUT (C),L & replace it with NOP,NOP
  - 9: search OUTI & replace it with NOP,NOP
  - 0: search OUTD & replace it with NOP,NOP
- CONTROL: start the game.

You really should use option '1' & '3' with games from Ultimate, such as Cookie, Jetpac, Psst etc. Options '4' & '0' should disable the majority of 128k music players. A file can be loaded by LOAD "filename" followed by nothing or DATA name() or DATA name\$() or CODE or CODE address or SCREEN\$. Disciple syntaxes like LOAD/MERGE d1/d2/d\* "filename" are also accepted, although the drive variables are not acted upon. Files are always loaded from or saved to the current record. It's even possible to use the microdrive command: LOAD "\*"m";1;"file" etc. A CODE file can be loaded to the screen area by supplying the SCREEN\$ keyword after the filename and the CODE file should be 6912 bytes or less. Also, SCREEN\$ files can be loaded to any address by LOAD "filename" CODE address. The MERGE command can be used to stop a BASIC file from auto-running after it has been loaded. The asterisk (\*) can be used with the LOAD, MERGE, VERIFY & OPEN commands.

*SAVE/LOAD/VERIFY commands examples:*

```
SAVE "name"  
SAVE "name" LINE line number  
SAVE "name" DATA numeric array name()  
SAVE "name" DATA string array name$()  
SAVE "name" CODE start,length  
SAVE "name" CODE start,length,autostart  
SAVE "name" SCREEN$
```

Make sure there is already a SAM file in the first directory entry as Spectrum files are saved to (hard)disk which can't be in the first directory entry. The file will not be saved if the length of the file is zero or if there isn't a file in the first directory entry or a MS-DOS disk/record was detected. Best thing to do is SAVE a dummy file as the first file in the directory entry from SAM BASIC:

```
SAVE "dummy" CODE 0,1 for example.
```

Code files that have an autostart address can be stopped from auto-running by:  
LOAD "name" CODE start,length,82.

Code files that don't have an autostart address can be made to autorun by:  
LOAD "name" CODE start,length,autostart.

Use LOAD "name" LINE x for BASIC programs, x = 0-9999.

The DISCIPLE & PLUS-D LOAD pn / VERIFY pn / MERGE pn commands are also accepted (n = number shown in the left-hand column of a detailed directory). This works with directory types mentioned above (including SNA, SP, LRM, Z80), except for array & TAP files.

CD-ROM drive: I've found out the following drives will work with my Emulator: Actima 36X & Funai 8X. However, a Philips 40X & a AOPEN 32X didn't work. You'll have to find out yourself whether your drive will work or not.

CD-ROM/CD-R: always open the drive tray using F9, then insert your favourite CD-ROM/CD-R and always close the tray using F8. Configure your CD-ROM drive as a slave drive.

To access a CD-ROM you must first select a unique RECORD (usually RECORD 1 or the last available RECORD). RECORD 1 is standard, but can be changed in BASIC LINE 52 after the DPOKE address. The normal CD-ROM drive speed is set to 2X speed in BASIC LINE 51, but can be changed up to 40X speed, assuming your drive can handle this speed! After a new CD-ROM/CD-R has been inserted using the F9/F8 keys and the CD-ROM drive RECORD has been selected, you