

# Interface 1bis for the Sinclair ZX Spectrum 48k Version 4b Hardware reference

## 1. Specifications

### 1.1 Memory

- One static RAM chip of 32 KB with battery back-up and adjustable voltage supervisory circuit, subdivided in two 16 KB blocks:

- 'BASIC ROM'
- 'Shadow ROM'

which can be paged in at address 0000, under software control

- A voltage supervisor disables the memory paging if the supply voltage drops below 4.75 V for longer than 2 microseconds.

- The 'BASIC ROM' and the first 11.5 KB of the 'Shadow ROM', used to store the operating system (OpSYS), are write-protected, under software control

- The last 4.5 KB of the 'Shadow ROM' are used as general purpose RAM.

### 1.2 Storage

One micro-SD card, operating in SPI mode at 12 MHz.

### 1.3 Peripheral ports

#### 1.3.1 Kempston joystick port

#### 1.3.2 PS/2 mouse port

#### 1.3.3 Full-speed USB 2.0 device port, used to connect to a server machine

#### 1.3.4 One auxiliary control line, on the edge connector

### 1.4 Controls

#### 1.4.1 Multi-function pushbutton with dedicated microcontroller

Four different functions can be performed depending on the duration of the push

- ON/OFF function: > 1.2 s toggles the 'active' - 'inactive' state of the interface

- RESET function: 0.5 - 1.2 s pulls the /RESET line low for 5 ms  
The /RESET control output is open-drain

- NMI function: 0.2 - 0.5 s pulls the /NMI line low for 5 ms  
The /NMI control output is open-drain

- SYSLD function: > 2.5 s the interface reloads its operating system from a file server or the SD card.

#### 1.4.2 Control LEDs

The six control LEDs indicate:

- LED 'O' the 'ON / OFF' state of the interface

- LED 'B' the 'BASIC ROM' is paged-in

- LED 'S' the 'Shadow ROM' is paged-in

- LED 'M' when on: the mouse is active as 'Kempston' mouse  
when blinking: the mouse is active as 'Kempston' joystick

- LED 'C' the SD card has been identified

- LED 'U' the connection to the server has been established

#### 1.4.3 ZX Spectrum model selector

The interface may be fitted with a jumper header for selecting the edge receptacle's pins that carry the 'ROM disable' signal

##### 1.4.3.1 'One ROM' (48k, +128, +2) machine

- Jumpers: 1-2, 3-4

- Signal pins: 4B, 25A

##### 1.4.3.2 'Two ROMs' (+2A, +2B, +3) machine

- Jumpers: 2-3, 4-5

- Signal pins: 4B, 15A

## 1.5 Connectors

### 1.5.1 SPI port (J8)

Pin	Name	Dir	Description
1	SDO	OUT	Serial Data Out
2	VDD	OUT	Regulated 3.3V
3	SCK	OUT	Serial clock
4	NC		Not connected
5	DSI	IN	Serial Data In
6	GND		Ground

### 1.5.2 SPI control (J7)

Pin	Name	Dir	Description
1	nEIT	IN	External interrupt
2	NC		Not connected
3	nECS	OUT	External chip select
4	NC		Not connected
5	nDIS	OUT	External reset
6	nRCS	OUT	Reserved
7	GND		Ground
8	nRCS	OUT	Reserved

## 2. Input / output port assignment

- The I/O address space used by the interface is: XXX11111

Port	IN	OUT
Peripheral control		
#1F	Kempston Joystick	Peripheral Data
#5F	Peripheral Status	
#9F	Peripheral Data	
#DF	Kempston Mouse	
Memory control		
#3F	Auxiliary line set	RAM write disable
#7F	Auxiliary line reset	Page-in the 'BASIC ROM'
#BF		Select the Spectrum ROM
#FF		RAM write enable
		Page-in the 'Shadow ROM'
		Select the IF1bis OpSys

2.1 Kempston Joystick / Kempston Mouse X: IN #1F / IN #BDF

- Bit assignment for Kempston joystick:
  - Bit 0 = Right Pin 4
  - Bit 1 = Left Pin 3
  - Bit 2 = Down Pin 2
  - Bit 3 = Up Pin 1
  - Bit 4 = Fire Pin 6 and 9
  - Bits 5-7 = 0
- Bit assignment for Kempston mouse X:
  - Bits 0-7 = X-coordinate

2.2 Peripheral Status / Kempston Mouse buttons: IN #5F / IN #ADF

- Bit assignment for Peripheral status:
  - Bit 7 = Peripheral busy
  - Bit 6 = Data ready
  - Bit 5 = Server connected
  - Bit 4 = SD card identified
  - Bit 3 = PS/2 mouse connected
  - Bit 2 = Ethernet module connected
  - Bits 0-1 = Not used
- Bit assignment for Kempston Mouse buttons:
  - Bit 0 = Right button not pressed
  - Bit 1 = Left button not pressed
  - Bits 2-7 = Not used

2.3 Peripheral Data: IN #9F / OUT #9F

2.4 Kempston Mouse Y: IN #DF / IN #FDF

- Bit assignment:
  - Bits 0-7 = Y-coordinate

2.5 Memory paging: ROM / RAM: OUT #7F / OUT #FF

- Bit assignment:
  - Bits 0-7 = Not used

2.6 Memory paging: 'Basic ROM' / 'Shadow ROM': OUT #3F / OUT #BF

- When the RAM is paged in
- Bit assignment:
  - Bits 0-7 = Not used

2.7 Memory paging: RAM write disable - enable: OUT #3F / OUT #BF

- When the RAM is paged out
- Bit assignment:
  - Bits 0-7 = Not used

## 2.8 Auxiliary line: Set / Reset:

IN #3F / IN #BF

### - Bit assignment:

Bits 0-7 = Not used

- The auxiliary control line is intended for the '80 KB Spectrum', where 64 Kbit DRAM chips have been fitted as 'upper RAM'.

Replacing the 'H' (for OKI) or respectively the '4' jumper (for TI) with a pull-up resistor and wiring the common 'L'-'H' or respectively '3'-'4' pad to the otherwise unused 28B pad of the edge connector, allows the mapping of two different 32 KB DRAM banks at address #8000

- The auxiliary line control output is open-drain and is connected to the interface's edge receptacle's pin 28B, for 'One ROM' and respectively 15A, for 'Two ROMs' ZX Spectrum models

### 3. Interface states

#### 3.1 The 'OFF' state

- The 'OFF' state is indicated by the 'O' LED being off
- After power-up the interface enters the 'OFF' state
- The interface can also be switched 'OFF' at any time, using the multi-functional pushbutton
- The interface does not respond to any I/O requests and implicitly cannot page memory
- The pushbutton is operational but no other interface functions are available

#### 3.2 The 'ON' state

- The 'ON' state is indicated by the 'O' LED being on while both 'B' and 'S' LEDs being off
- The interface can be switched 'ON' using the pushbutton
- The interface does respond to I/O request but its RAM is not paged in
- The ZX Spectrum is running the '48k BASIC', from its internal PROM
- The Kempston joystick and mouse are operational

#### 3.3 The 'Active' state

- The 'Active' state is indicated by either the 'B' or 'S' LEDs being on
- The interface can be switched from the 'ON' state to the 'Active' state by triggering a NMI, using the pushbutton
- The interface can be switched back from the 'Active' state only to the 'OFF' state, using the pushbutton
- The interface is fully operational
- The ZX Spectrum is running the 'Extended BASIC' from the interface's on-board non-volatile RAM.
- The 'B' and 'S' LEDs indicate whether the 'BASIC ROM' or respectively the 'Shadow ROM' is paged in