

A ZX Spectrum Diagnostic Test ROM by Phil / www.retroleum.co.uk

V1.12

Description:

A ROM image that can be used to help diagnose faults with ZX Spectrum computers. It tests RAM, ROM, keyboard, interrupt, bus and colour palette. (The Spectrum ROM test options require the Retroleum SMART Card but everything else should run on any ROM replacement system.)

RAM Tests:

On power on / reset, the Spectrum should beep once and show a title page. The border then goes yellow and the lower 16K of RAM is tested, this takes about 15 seconds and garbage appears on screen during the test - this is normal. If this test encounters bad RAM, an error message is shown, with the bad bits underlined. In case the display is unreadable (or the Spectrum is not connected to a TV) the bad bits are indicated by a sequence of 8 beeps (from bit 7 to bit 0) A high beep is a good bit, a low beep is a bad bit. The good/bad bit status is also indicated by stripes in the border, the topmost stripe being bit 7 (green=bit OK, red=bit bad). If the lower RAM is OK, then just 2 short beeps are heard.

Next, the Upper 32KB of memory is tested (if fitted*). This takes about 30 seconds and the border is magenta during this stage. Again, if there are problems an error message is shown and there are beeps to indicate the bad bits. If the upper RAM is OK, 3 short beeps are heard.

* The ROM attempts to detect the presence of the upper 32KB by writing \$0000 to \$8000+\$8001 and then reading the same locations. If the word reads back \$ffff this is taken as "RAM not fitted".

Other Tests:

If at least one RAM test completes successfully, the following extra tests can be run:

- Keyboard
- IRQ
- Speaker
- Floating bus
- Colour pattern test
- ROM
- Spectrum 128 Tests

(Upon entering the menu, bits 4:0 of port 254 (keyboard columns) are not \$1f, then a warning is shown.)

If no key is pressed in a while, the RAM tests run again.

Keyboard Test

Displays a keyboard diagram with the pressed keys highlighted. Press caps shift and space to quit.

IRQ Test

This test makes sure the Z80 is responding to the /INT signal being driven low by the ULA at the start of every frame (a block should smoothly travel across the screen) The test quits when the block reaches the bottom right of the display.

Speaker Test:

Simply plays a sequence of tones from the onboard speaker.

ROM Test

Pages out the SMART card's ROM and makes a CRC16 checksum of the Spectrum's internal ROM. This is compared to a list of known checksums. The "Sinclair/Amstrad" Copyright message is also checked.

Floating bus Test

The floating bus effect is used by some games to synchronize graphics routines etc. It involves reading an unimplemented port and examining the data that appears there (it should be whatever byte the ULA was processing at the time). This test fills \$4000-\$57ff with some data, then sits in a loop reading from an unused port (\$255) ANDing \$7 and writing the result to port \$254, so changing the border colour to reflect whatever was on the databus at the time of the read. A rainbow pattern with a break in the middle should appear in the right border. Press any key to quit. (The floating bus effect does not occur on the Spectrum 128 +2 / +3)

Colour Test

Shows various pattern with solid blocks of colour etc, normal and bright versions. Press any key to cycle through the 7 border colours, then quit.

Spectrum 128 Tests

A new menu is shown with 4 tests:

1. Memory: The extra memory of the Spectrum 128 is tested as follows: First, each 16KB bank at \$C000-\$FFFF is tested and any errors are highlighted. (Garbage will appear on screen while bank 5 is tested - this is normal). Afterwards, the memory paging system is tested by writing N to the first and last bytes of each bank (where N is the page number) and then reading them back.
2. Video Page - The 128's screen buffering system is tested by flipping the display select bit (alternating red and blue screens with text should be displayed).
3. ROM – Checksums of the 128's two ROMs are calculated and compared to a database of known values.
4. AY Sound chip: The AY sound chip is tested by playing 3 tones (one for each channel) and then 3 bursts of white noise.

Notes:

1) If an NMI is detected at any time, the program will display "*** Non Maskable Interrupt! ***" and restart.

2) RAM test technique: All locations are written with 00 and verified, then all locations are written with \$ff and verified. Next, a bit is rotated across each byte of memory and after each pass the contents verified. This is repeated with an inverse pattern. Finally random data is written to all locations, and verified after each pass. This is repeated 8 times, with different data. If an error is encountered the expected byte (XP) and byte actually read (RD) are displayed along with the address at which the error occurred. The bits that do not match are indicated via the aforementioned audio/visual methods and the corresponding suspect IC(s) are listed.

In the Spectrum, each RAM chip contributes one bit to each memory byte, so the faulty chip can be identified from the bit position as per the following tables:

SPECTRUM 16/48	Faulty Chip	
Bad Bit:	(Lower 16K)	(Upper 32K)
0	IC6	IC15
1	IC7	IC16
2	IC8	IC17
3	IC9	IC18
4	IC10	IC19
5	IC11	IC20
6	IC12	IC21
7	IC13	IC22

Bad lower RAM chips normally result in vertical lines on the display (when the diagROM is running). If no such lines are present, it is possible there is a fault with IC3 or IC4 (74LS157) especially if text appears in the wrong place etc.

SPECTRUM 128	Faulty Chip	
Bad Bit:	(BANKS 1,3,5,7)	(BANKS 0,2,4,6)
0	IC6	IC15
1	IC7	IC16
2	IC8	IC17
3	IC9	IC18
4	IC10	IC19
5	IC11	IC20
6	IC12	IC21
7	IC13	IC22

Bank 5 is also the Lower 16KB [\$4000-\$7FFF] which is also tested by the standard Spectrum 48 RAM test.

Bank 2 is the first half of the upper 32KB RAM [\$8000-\$BFFF] - this is also tested by the standard Spectrum 48 RAM test at start-up (The second half of this upper RAM test [\$c000-\$FFFF] will be bank 0)

For more information you can contact me at: smart-info@retroleum.co.uk