# Horizon 2.1

# BBC Micro Emulator

# User Guide

**Author: Chris Lam**

**Copyright 1995-2012**

**www.chrislam.co.uk**

**Document Revision: 2.1**

# Introduction to Version 2.0

Welcome to Horizon 2.0. It's been 13 years since I last updated Horizon so it's not surprising that version 2.0 is a substantial re-write with some major improvements. It provides much better emulation as well as support for disk drives, tape system, a variety of full screen and display options, joystick support, sideways ram, improved sound with speech, and lots more. I have also made available the debugging tools I used for development.

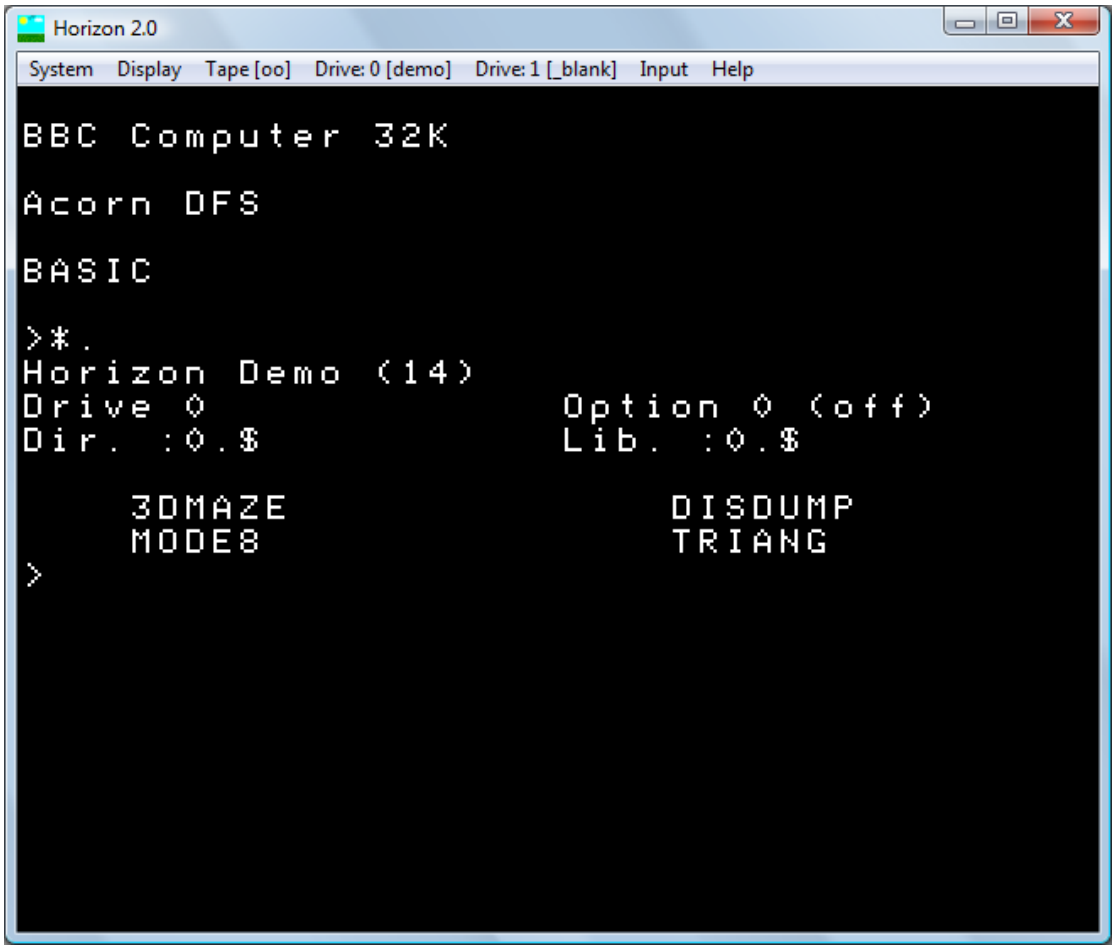
It's been fun revisiting all this stuff… any suggestions or bugs please let me know, as I will be updating Horizon more frequently in future.

For a history of release changes, visit www.chrislam.co.uk

# Getting started

Horizon emulates the Acorn BBC Micro (Model B) with 32K RAM. B+ and Master models are not supported.

You also need to install Microsoft Visual C++ 2010 Redistributable Package.



A demo disk (demo.ssd) has a number of programs including TRIANG, 3DMAZE, DISDUMP (disassembler utility) and MODE8, the latter demonstrating the BBC Micro's hidden extra screen mode. These programs are also provided in the Tapes folder; to load do a *TAPE, select the tape folder "demo" and type CHAIN "xxx". Stellar Rescue can be loaded via the tape system (it needs PAGE at &E00 so remove DFS first).

See the Appendix for tips on getting games to run on Horizon.

## Display options

Horizon 2.0 provides a number of display modes. There are 3 window modes: 640x512, 960x768 and a maximised window mode. There are also 2 full screen modes, one with the menu bar and one without.

Use ALT+space bar to rotate between window mode, full screen with menubar and full screen without menubar. In full screen mode click the mouse to show/hide menu bar.

In full screen mode (or maximised window) you can hide vertical overscan to give a much bigger display, e.g. Revs fills the screen. Ignoring aspect ratio also helps fill the screen. These adjustments are handy for games with letterbox views like Manic Miner or Citadel. In the smaller window displays the aspect ratio has no effect.

Show FPS (frames per second) is used to see whether Horizon is running at normal BBC Micro speed, which is 50 fps with 100%. A value of 200% means it is running at twice BBC Micro speed. Disabling the "100% Speed Cap" under the System menu makes Horizon run flat out. Drawing only "25 frames per second" will make it run faster still and is an option for slower PCs.

## Disk Drives

Two disk drives (0 and 1) are available. When an image has been modified an asterisk will appear next to the name in the menubar, and Horizon will always prompt you to save it before removing the image or exiting Horizon. Ticking Write Protect will prevent any write to the image.

Images up to 80 tracks of 10 sectors, 256 bytes per sector are permitted (204,800 bytes). Horizon saves disk images economically by omitting any blank space at the end of the disk.

Drives 2 and 3 are the same as 0 and 1. No need to format disks, just insert _blank.ssd whenever you need a blank disk.

The following DFS ROMs have been tested. Other DFS ROMs may or may not work. Check the MD5 if you are having problems; there are many variants of DFS ROMs on the web. Note that Horizon emulates the 8271 disk controller chip (not the 1770).

| DFS | Notes | MD5 |
|---|---|---|
| Acorn DFS 1.20 | Default DFS for all testing on Horizon | 5daed103918277e2065dd7e8d23e57a5 |
| Acorn DFS 0.98 | Some games may need older DFS 0.9x | 5a3ddfae96178e025f27bf1f69bfa629 |
| Acorn DFS 0.90 | | 803530149c274994fabc6d28cbe03679 |
| Watford DFS 1.44 | Good, full featured DFS | 1d250b0242e447e9106e8bfd1f27ea84 |
| E00 DFS | See Sideways RAM section | 73ce9cddd3322021640868deb4277182 |

The “auto boot” option will simulate a Shift+Break event after a disk image is inserted into drive 0. In fact it a power up with Shift pressed, as this will remove any effects of the previous game. The auto boot is only attempted if the disk has been set with *OPT 4 n where n is not zero. The “auto boot” option can be set to on when Horizon starts up (see Horizon.config). This means you can set up the config file for auto boot on and a bootable disk image inserted, which means Horizon will boot the disk when it starts up.

Note: the auto boot option may cause a prolonged beep when booting, as Shift is pressed during a *power up*, rather than a Break.

If a disk image file is read only then the “Write Protect” setting is ticked.

# Tape System

For games provided as separate files these can be loaded via the BBC Micro’s tape system. Select the tape folder (this is like loading a cassette and only files in this folder are accessible), then type *TAPE (if DFS is present) and CHAIN ”xxx” or *RUN xxx.

Note: *SNAPPER is not permitted by the tape system, use *RUN SNAPPER

When Horizon detects that files are being accessed using the tape system it ignores the “100% Speed Cap” and runs at full speed. This way the tape system runs at an acceptable speed, albeit not a realistic one.

*CAT (or * dot) provides list of files in the selected folder. Files ending in .txt, .config and .inf are ignored. For faster *CAT, tick “Fast *CAT” option which will only read the first block of each file; however you won’t see details such as file length. Press escape at the end of the operation, as with a real BBC Micro.

For some games it may be necessary to use *OPT1,0 to hide messages as the game loads, otherwise the text may overwrite parts of the game’s data, especially if code loads into the visible screen area (which is often the case).

When saving the familiar “Record Then Return” message appears. There is then a 5 second delay before the file is saved. Files are saved to the selected folder (or the Tapes folder if none selected).

Each file can have its load and execution addresses held in an INF file or, as with older versions of Horizon, in a 10 byte header (see Appendix). Horizon now favours the INF file method; any saves to the tape system will generate an INF file. Horizon 2.0 is backward compatible with files with the old 10 byte header.

Having the disk and tape systems available provides an easy way to extract files from disk into separate files and, of course, to convert tape files into a disk image.

Tip: Create a BASIC program called GO in each of your Tape folders which kicks off the load; this way you can simply type CH.”GO” for any of your tape games. Put *OPT 1,0 in GO if necessary.

## System options

“Power up” resets the BBC Micro (the same as switching a real BBC Micro off and on again); it also re-reads the Horizon.config file and re-loads ROMs and DIP switch settings. All other settings are read only when Horizon starts up.

“100% Speed Cap” limits Horizon to actual BBC Micro speed.

By default Horizon pauses when the app loses focus. Should you want it running while you check your email tick “Run in background”.

The “ROM 14/DFS” option gives you a quick way to enable/disable a paged ROM. Most useful would be to put your DFS ROM at socket 14. See section on Horizon.config for more about setting up your ROMs.

## Sideways RAM

Each ROM socket (0 to 15) can be set up be Sideways RAM. Each such socket is a bank of 16K RAM at address space &8000-&BFFF. This can be used with Exile and E00 DFS.


Note: Exile will always use the Sideways RAM socket with the highest number. This may conflict with E00 DFS. To resolve this set up Horizon.config as follows:

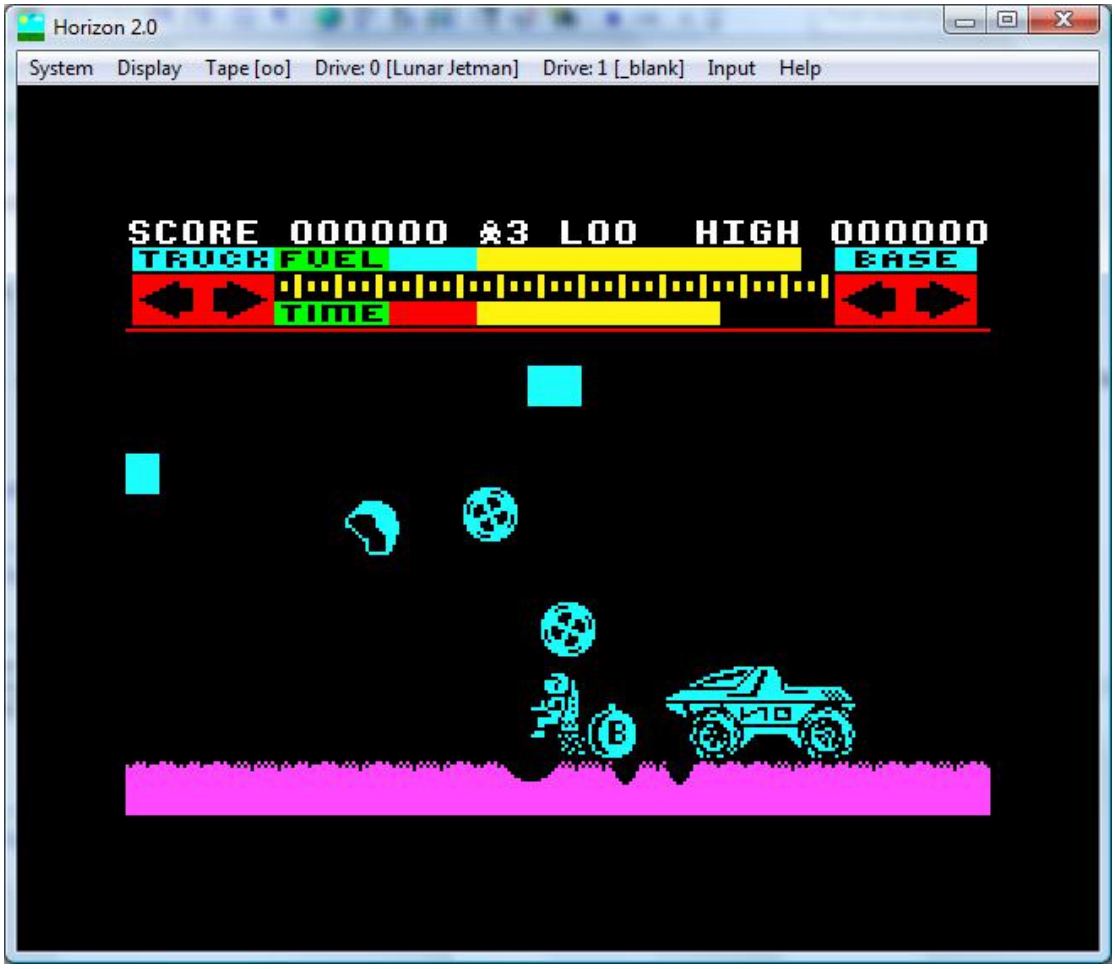
SOCKET 14 SWRAM
SOCKET 13 SWRAM DFS E00/E00dfs.rom

Exile will use bank 14, leaving bank 13 for E00 DFS.

## Keyboard

All BBC Micro keys are mapped to the PC keyboard. Extra keys are:

| PC Key | BBC Micro Key |
|---|---|
| F12 | Break |
| Page Up | Shift Lock |
| Page Down | Copy |
| Delete or Backspace | Delete |
| F10 | F0 |
| F1-F9 | F1-F9 |
| Numeric Keypad | F0-F9 |




The colon can be mapped to the apostrophe to give the convenient : and / combination for up/down in many BBC games. The colon can also be mapped to the whole apostrophe key such that Shift+' gives * rather than @. This is needed for games like Lunar Jetman.

In addition Caps Lock and Ctrl can be mapped to ZX for the popular left and right combination.

Note that BBC Micro's Caps Lock is not synchronised with the PC's Caps Lock. Otherwise Horizon would have to set PC's Caps Lock on every time, which is quite annoying.

All Horizon menu shortcuts use the ALT key to avoid conflict with BBC Micro keyboard.

Be sure to turn off Window's Sticky Keys, as this will get in the way of using Horizon.

The Break key (F12) can be used with the Shift and Ctrl keys to provide the usual functionality on a BBC Micro. In addition Alt+F12 is power up. Pressing F12 with any other key will turn off DFS (as on the BBC Micro) but PAGE remains at &1900.

# Joystick Support

You can use joysticks in a number of ways with Horizon. Plug in the joysticks before launching Horizon. Then click “Show joystick inputs” in the Input menu. This will provide feedback as to whether the joysticks are detected ok. These numbers will also help you to identify buttons for use with the joystick mapping feature.

If you don’t have a PC USB joystick you can buy cheap ones off Ebay for £5. The one below has 4 shoulder buttons and the analogue sticks work too.


## *Native joystick support*

If the game says “Press Fire to play” then that’s all you need to do. Two player games are supported with both players using the same one joystick or 2 separate ones. If a joystick is being shared the fire buttons will differ for each player.

Match Day or Way of the Exploding Fist are good examples of a two player game with joysticks.

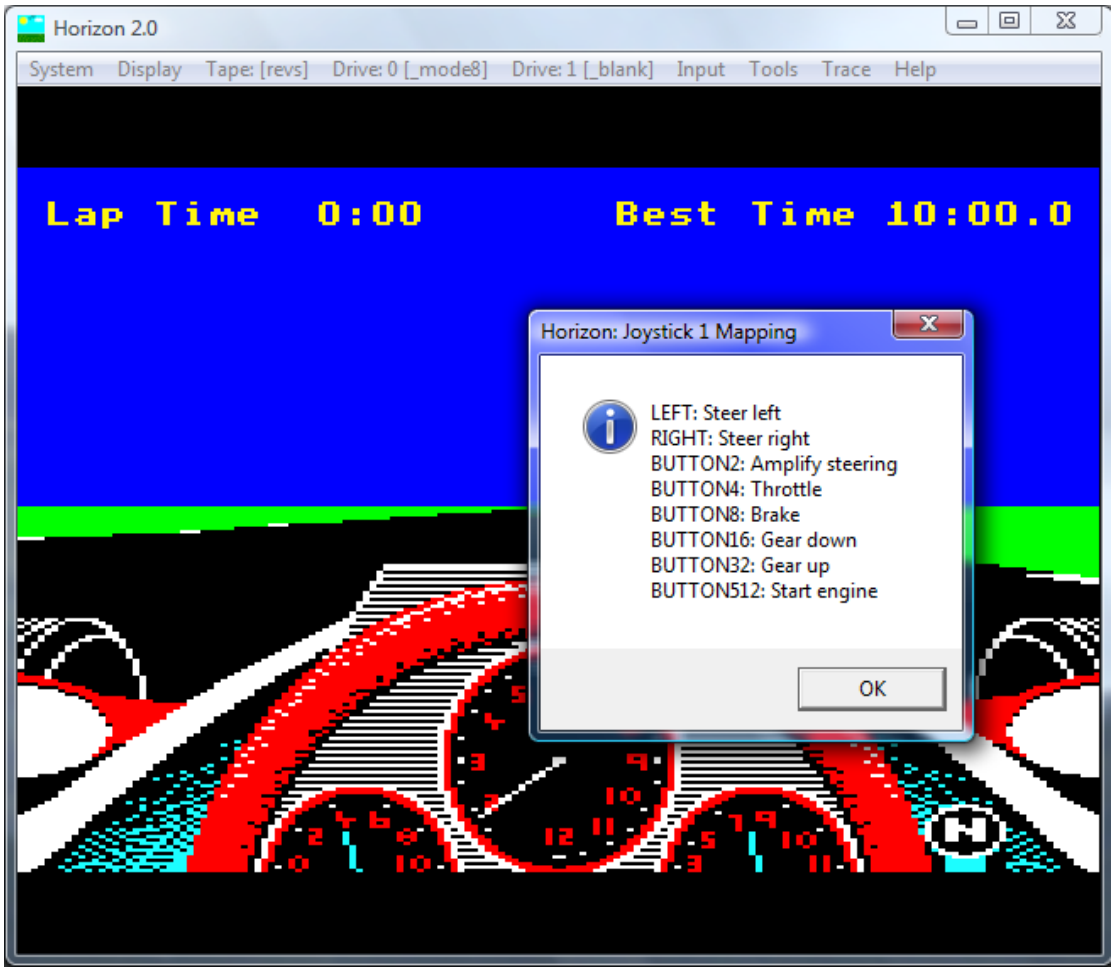
## *Joystick mapping*

Some games don’t offer joystick support but you can still use a joystick by defining a **joy.config** file which maps the joystick buttons to keyboard buttons. See Joystick mappings folder for examples.

This means that you can play Revs with a Playstation-style controller which is much better than the game’s own native joystick support.

Place the joy.config file in the game’s tape folder (tape system) or in the same folder as the disk image (keep each disk image in its own folder). Then select the tape folder or insert disk image in drive 0 (not 1); this is when Horizon looks for joy.config in that folder. Click “Show joystick 1 mapping” and your

mapping should appear. This reminds you of the game's buttons without having to open joy.config. You can now use the joystick for the game.




The joy.config file is only loaded if a joystick is connected.
If you set up Horizon.config to insert a default disk image at startup joy.config will be loaded.

Note the button numbers in the screenshot. E.g. button 512 refers to the button that displays 512 when you press it with the "Show joystick inputs" option on.

## *Joystick emulation using keyboard*

A final way of using "joysticks" is to emulate a joystick using the cursor keys and Control/Shift keys. Again 2 players can the use the "joystick" alternately; fire for player 1 is Control and Shift for player 2. This option is useful as it provides a standard set of keys across different games.

# Sound and speech

As part of the improvement to sound, Horizon can now play samples sent to the sound chip (not to be confused with the speech chip which is not emulated). Sampled speech can be heard in intros to Repton 2 & 3, Citadel, Bonecruncher and Spy Hunter. Exile has in-game speech. Superior Software's SPEECH! ROM can be used say ad-hoc sentences.

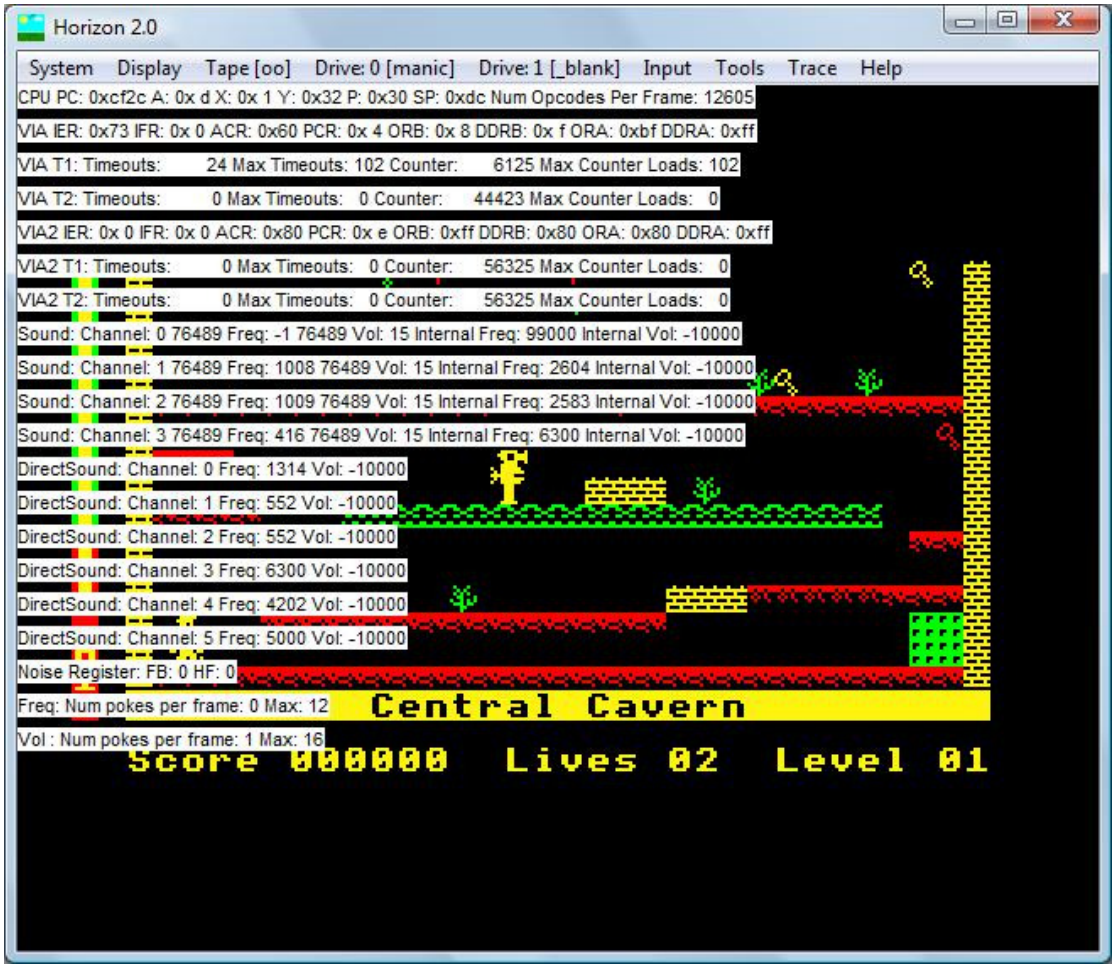
# Tools and Trace

The menus for Tools and Trace can be turned on in Horizon.config. These diagnostic features allow you to see the internal workings of the BBC Micro, everything from viewing CRTC registers to tracing the 6502.

## *Tools*

The "Show" tools display a heads-up view of the internal state of certain chips. Be careful when interpreting these values… some of values are sampled at set times in phase with the vertical sync. Just as a spoked wheel spinning at a certain speed appears to be stationary, so too these values (e.g. in the VIA) may give the appearance of being static. The only way to examine the values properly is using the Trace tools. Nevertheless these Show tools provide some insight.

The PALETTE and ULA displays values over the entire frame so you can see how values change as the screen is being drawn. The first array index is the value of the scanline (0..312).




The VIA timers may also be disabled. This can help identify which timers are doing what.

You can also prevent MOS from clearing down the memory on power up. Then use a ROM like Monitor to look at the code.

Some games use illegal (or undocumented) opcodes, e.g. Zalaga. If a game fails to run it may be down an illegal opcode not being implemented properly. The behaviour of some illegal opcodes is, by definition, not always well known and may require some attention when there is software to test with. The “Alert” option will inform you an attempt to execute such an opcode was made. Then use the Trace tools to follow it up. The Alert will alert you only once per power up.

Bullet Time slows the execution down to a crawl, handy for examining counters, etc.

## *Trace*

The Trace tools allow you to create a log file of certain BBC Micro activities. All files are written to the Trace folder. You can trace:

- CPU execution (this will create a very large file in only a few seconds, so use sparingly). The value in square brackets is the target address to act on, which is helpful for complicated instructions such as STA (&FC),Y. The time given is the number of machine cycles (2MHz) since the start of the frame. ROM is the bank currently paged in.

- CPU execution of illegal opcodes only. Illegal opcode names starts with double underline, e.g. __LAX

- VIA Timer events (such as timeouts, counter loads, interrupts raised)

- CRTC / VIA / Mapped memory (&FE00 - &FEFF) reads and writes

- Disk (8271) and tape (ACIA) activity

- All pokes to the 76489 sound chip

Select “Start Tracing” to begin. Only when you stop tracing will the trace file (Horizon System Trace.txt) be available for examination.

“Dump RAM To Files” will write out RAM to a number of files. One of these is the RAM area &E00 to &7FFF. If you rename this to, say, MEM, and create an appropriate INF file then you can load this into Horizon via the tape system and examine it with the Monitor ROM. If you want to examine sideways RAM, set socket 0 to be sideways RAM and this will be dumped out. The ROM paged in at the time of the dump is also dumped.

# Appendix A: Horizon.config file

This file contains the startup default for various settings including ROM sockets, DIP switches and disk images. The file is commented and should be self-explanatory.

The config file is always reloaded on power up. However the menu and drive settings are only used when Horizon starts up; the socket and DIP settings are reread every time. Thus means you can modify socket and DIP settings whilst Horizon is running and power up to pick up the new settings.

Use /* and */ to comment a block of lines. Examples are provided as a guide.

If you change Socket 14 while Horizon is running you make need to tick the “ROM14/DFS” menu item to enable it.

The SOCKET syntax is:

```
SOCKET <bank number> <type> <filepath>
```

where

<bank number> is 0..15
<type> is ROM (read only) or SWRAM (read/writeable)
<filepath> path of the image to use (from ROMs folder)

For SWRAM (sideways RAM) you can initialise the bank with a ROM image, or omit it. ROMs must always have a filepath.

Examples:

SOCKET 15 ROM Basic Roms/Basic2.ROM
SOCKET 14 ROM DFS Acorn/DFS120.ROM
SOCKET 10 SWRAM
SOCKET 0 SWRAM SPEECH!.rom

# Appendix B: Old Horizon File Headers

Older versions of Horizon embedded the load & exec address in a 10 byte header as part of the file. Horizon 2.0 abandons this method in favour of INF files. However for backward compatibility Horizon 2.0 will read the header if there is no INF file. Horizon 2.0 will create an INF when writing files.

The header consists of 10 bytes in the following format.

| Offset | Byte | Comment |
|---|---|---|
| 0 | 255 | Must always be 255 |
| 1 | L-LO | Load address |
| 2 | L-HI | |
| 3 | E-LO | Execute address |
| 4 | E-HI | |
| 5 | * | Checksum |
| 6..9 | 0 | Four spare bytes |
| 10.. EOF | data | File data proper |

The checksum * is computed as (L-LO + L-HI + E-LO + E-HI) & 255. If this check fails or if the first byte is not 255, Horizon will refuse to load the file. The last 4 bytes are currently unused and may take any value.

# Appendix C: INF files

For tape files, each file needs an INF file (or the 10 byte header). The contents of an INF file may look like:

$.XYZ FF1900 FFFF19AE 2000 Locked CRC=23ED

$.XYZ is the name of the file, the load address is &1900 and the execute address is &19AE. The other info are not important to Horizon.

When Horizon creates an INF file it only writes the filename, load and exec addresses.

# Appendix D: Tips for running BBC software

For a list of titles tested on Horizon visit www.chrislam.co.uk

Here are some general tips on getting software to run on Horizon.

Make sure the images and files are of good quality. There are plenty of duff BBC Micro files on the web, some hacked without any testing. I recommend downloading from trustworthy websites, like Stairway To Hell.

Always power up before loading a game.

Some ROMs may conflict (e.g. SPEECH! with Repton 3 and Elite). Try removing unnecessary ROMs and sideways RAM.

Some games may come as a collection of separate files, extracted from a disk image. Trying to load this via the tape system may present problems, as the code may use disk commands which do not exist in the tape system. For example *SNAPPER is not allowed in tape system, it should be *RUN SNAPPER. Filenames may need to be renamed to include or exclude directory letters. It may require some effort to get such a game working so it's probably simpler to look for another version of the game, preferably as a disk image.

PAGE value may be a problem for some games. For tape based games, trying removing DFS ROM. You can use E00 DFS to set PAGE to &E00 and still have disk access. Some games however may expect Acorn DFS or PAGE to be set to &1900.

Tape based games may need *OPT1,0 before loading to suppress messages (see Tape System section).

Make sure any keys required in the game are remapped properly (under Input menu) (see Keyboard section).

The version of BASIC (1, 2 or 3) and MOS (1.20 or 1.00) may have an impact. E.g. Elite only boots up with BASIC 1 or 2. The DFS version may also have an effect, e.g. with Donkey Kong Jr where DFS 1.20 interferes with the music and crashes the game; however game is ok with DFS 0.9x.

If your favourite game doesn't work, let me know.

# Appendix E: Problems running Horizon

Horizon 2.0 is primarily targeted at Windows 7 and Vista. However Windows XP should work ok.

Full screen modes may inadvertently show the Windows taskbar (especially in XP), but press ALT+Space a few times and it should disappear. In Windows 7 and Vista you can specify whether the taskbar should display on top of other windows, if problems persist.

If sound is a bit crackly check your version of DirectX. XP users can try turning off hardware acceleration to see if sound quality improves. Turn off any other sound card effects (like echo, 3D surround, etc.) to hear the BBC Micro sounds as nature intended.