

ZoomTape Manual -- DRAFT VERSION

v1.0 - Sep 28 2012

This manual describes how to install and use the ZoomTape tape drive adapter. The ZoomTape is a daughter board for ZoomFloppy: It connects your Commodore 1530/1531 tape drive to an already installed and working ZoomFloppy. This allows you to read and write tape images to and from the original media.

The tape image format used is CAP. Applications for tape image conversion between CAP format and standard emulator TAP format are provided.

Tapes can be imaged as long as the magnetic tape signal frequency does not exceed about 15kHz (USB transfer takes some time). Almost if not all original C64/C16/VC20 format tapes should be compatible.

Power for both the ZoomTape and tape drive is provided by an external power supply unit.

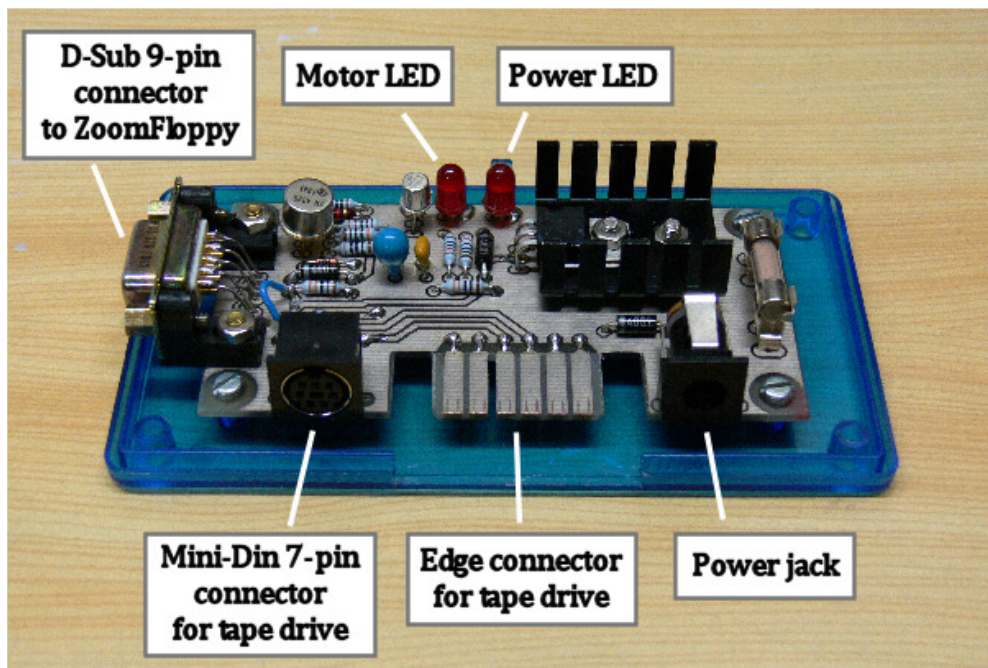
Disk drives attached to ZoomFloppy interfere with the tape drive attached to ZoomTape.

For best tape signal quality it is not allowed to attach any other drives to ZoomFloppy and ZoomTape than a single tape drive.

USB transmission is critical while reading/writing tapes. Keep your CPU and USB load at a minimum to ensure best tape imaging. Tests were performed on an Intel Core2Duo 2GHz CPU.

PLEASE READ THE "WARNINGS" SECTION AT THE END OF THIS DOCUMENT BEFORE PROCEEDING. IMPROPER USE OF THE ZOOMTAPE MAY DAMAGE YOUR HARDWARE.

Introduction to the ZoomTape (Picture showing early prototype!)



The ZoomTape device can be operated in two modes:

Standalone mode

In standalone mode ZoomTape is not connected to a ZoomFloppy. It allows using only the most basic tape drive operations, e.g. rewind and fast forward. Tape imaging is not possible in standalone mode. The tape drive motor may be powered on by manually setting a jumper to JP1.

Normal tape operation mode

In normal tape operation mode the ZoomTape works as a daughter card for the ZoomFloppy. This is the default mode for tape imaging.

At a minimum, the ZoomTape must be connected to:

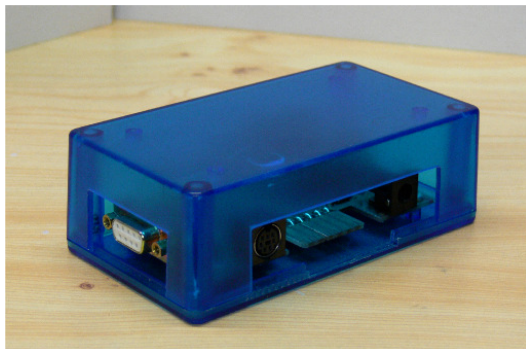
- a single tape drive either via the Mini-DIN connector or via the edge connector,
- a fully functional ZoomFloppy (with ZoomTape firmware add-on) via cable from ZoomTape's DB9 connector to ZoomFloppy's GPIB plug,
- the external power supply unit plugged into the power jack.

The red "Power LED" shines as long as power is provided by the external power supply unit. The red "Motor LED" shines as long as power is routed to the tape drive motor.

Power supply for the tape drive motor is controlled by software or manually, but the software setting takes priority. If the ZoomFloppy is not set for turning the tape drive motor off, it can be powered on manually by setting a jumper to JP1.

Optional enclosure

ZoomTape was designed to be placed in an enclosure, but works just fine as a bare board. The recommended enclosure is manufactured by Hammond, part number 1591XXCTBU. Please refer to <http://www.hammondmfg.com> for details. It is available from many distributors, such as Digikey or Conrad. You'll have to cut into two sides of the enclosure to allow for the connectors and appropriate heat exchange.



Windows installation

The ZoomTape depends, as a daughter board, on the fully operational state of the connected ZoomFloppy. Please refer to your ZoomFloppy manual for installation, setup and proper operation on Microsoft Windows operating systems. The latest version of OpenCBM drivers with ZoomTape support are required to be installed and working. The connected ZoomFloppy has to be equipped with the latest firmware supporting ZoomTape.

Tape imaging on Microsoft Windows

A few commandline applications and a GUI application are provided with the ZoomTape. You may run them without commandline flags for help output (not Tapview).

- tapread.exe - Create image files from tapes.
- tapwrite.exe - Write image files to tapes.
- cap2tap.exe - Convert CAP images to standard TAP format.
- tap2cap.exe - Convert standard TAP images to CAP format.
- tapcontrol.exe - Turn tape drive motor on/off.
- tapview.exe - Visualize CAP image signals (GUI application).

tapread.exe

General usage:

- tapread <type> [buffer size] [sampling rate] <filename.cap>

Examples:

- tapread -c64pal myfile.cap
- tapread -c64pal -b50 -s16 myfile.cap

You must specify what computer and video type your tape is made for, possible choices are: -c64pal, -c64ntsc, -c16pal, -c16ntsc, -vicpal, -viciantsc, -spec48k.

You may use -x for custom/unknown tapes, but you can't use "cap2tap.exe" afterwards.

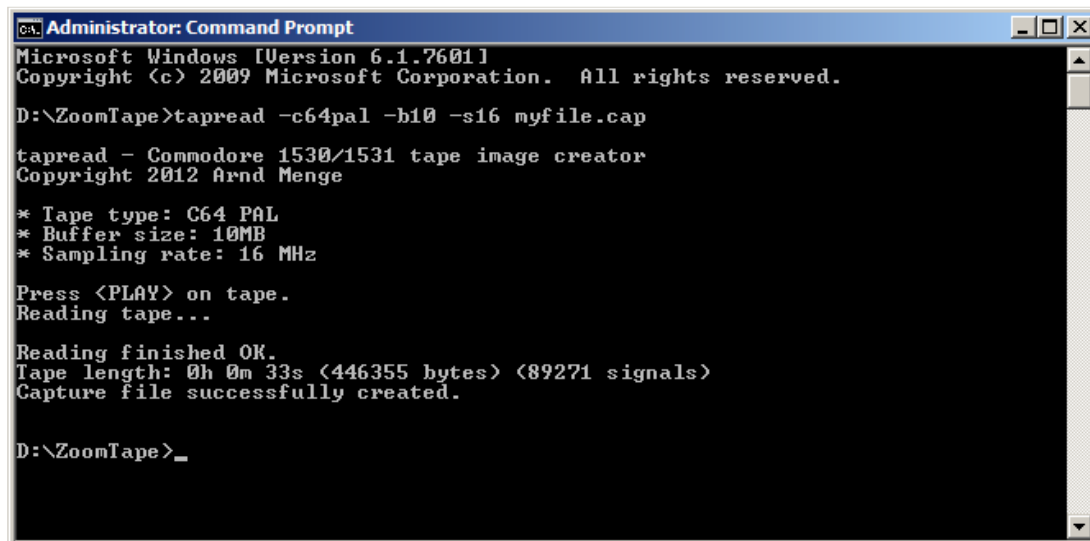
Computer memory is required for temporary storage of your tape images. The default memory buffer size is 25 megabytes. You can optionally specify a larger or smaller buffer size if you expect your tape images to be larger or smaller. Possible choices (in megabytes) are: -b10, -b25, -b50, -b100.

The tape image files you create get populated with timings of the magnetic signal changes received from your tape drive. Specification of the sampling rate is optional. The default sampling rate is 1 MHz which corresponds to a signal precision of 1 microsecond (us). This precision is usually ok. The best possible sampling rate is 16 MHz which corresponds to 62.5 nanoseconds (ns) signal precision. Possible choices are (in MHz): -s1, -s16.

The tape image is stored to the file you specify under filename.cap.

Note: You need a clean and calibrated tape drive and clean and undamaged tapes. Even the slightest damage to the magnetic tape media may introduce noise to the tape signal, rendering your tape images non working. Repeatedly.

Demonstration screenshot:



```
Administrator: Command Prompt
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

D:\ZoomTape>tapread -c64pal -b10 -s16 myfile.cap

tapread - Commodore 1530/1531 tape image creator
Copyright 2012 Arnd Menge

* Tape type: C64 PAL
* Buffer size: 10MB
* Sampling rate: 16 MHz

Press <PLAY> on tape.
Reading tape...

Reading finished OK.
Tape length: 0h 0m 33s (446355 bytes) (89271 signals)
Capture file successfully created.

D:\ZoomTape>
```

tapwrite.exe

General usage:

- tapwrite [-aX] [-bY] [-bz] <filename.cap>

Examples:

- tapwrite myfile.cap
- tapwrite -a15 myfile.cap
- tapwrite -a15 -b30 myfile.cap
- tapwrite -a15 -bz myfile.cap

You may optionally specify start and stop delays:

- "-aX" lets the tape software wait X seconds on record before the first data signal gets written to tape.
- "-bY" keeps the tape on record for Y seconds after the final signal got written to tape. Recording stops early when the tape ends or <STOP> is pressed.
- "-bz" keeps the tape on record for the maximum possible time (about 9 hours) after the final signal got written to tape. Recording stops early when the tape ends or <STOP> is pressed.

Sometimes tape images do not have an initial pause of a few seconds, they immediately start with data signals. You need to specify a start delay if you want to record such a tape image right from the start of a tape.

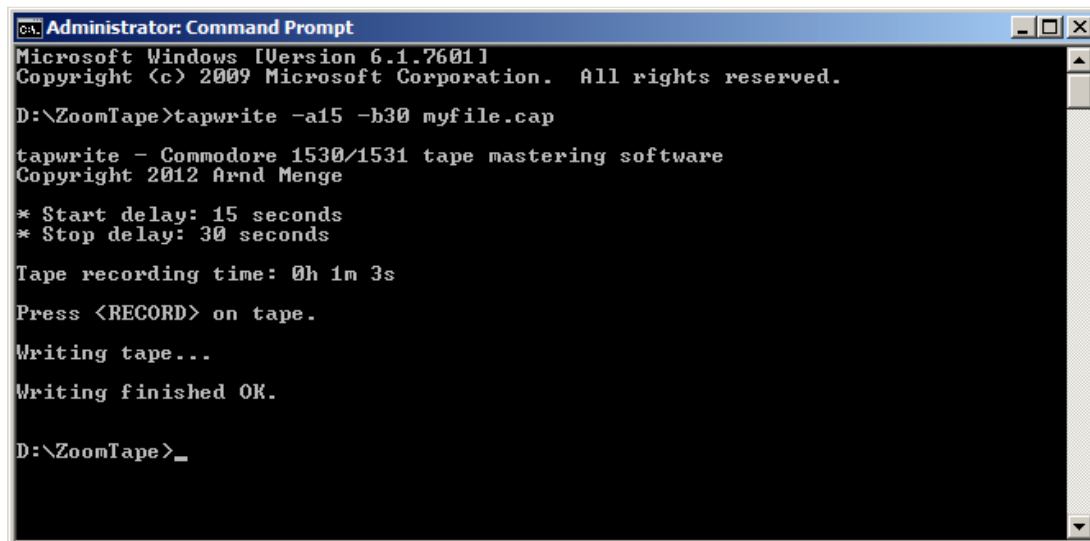
Tape recording stops immediately after writing the last signal by default. You may specify a stop delay to keep the tape on record without writing data.

The tape image you specify under filename.cap is written to your tape.

Note: Writing Spectrum 48K tapes is experimental and might not work.

Note: You need a clean and calibrated tape drive and clean and undamaged tapes. Even the slightest damage to the magnetic tape media may introduce noise to the tape signal, rendering your written tapes non working. Repeatedly. Consider buying new tapes if you want to use tapwrite.

Demonstration screenshot:



```
Administrator: Command Prompt
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

D:\ZoomTape>tapwrite -a15 -b30 myfile.cap

tapwrite - Commodore 1530/1531 tape mastering software
Copyright 2012 Arnd Menge

* Start delay: 15 seconds
* Stop delay: 30 seconds

Tape recording time: 0h 1m 3s
Press <RECORD> on tape.
Writing tape...
Writing finished OK.

D:\ZoomTape>_
```

cap2tap.exe

General usage:

- cap2tap <input.cap> <output.tap>

Example:

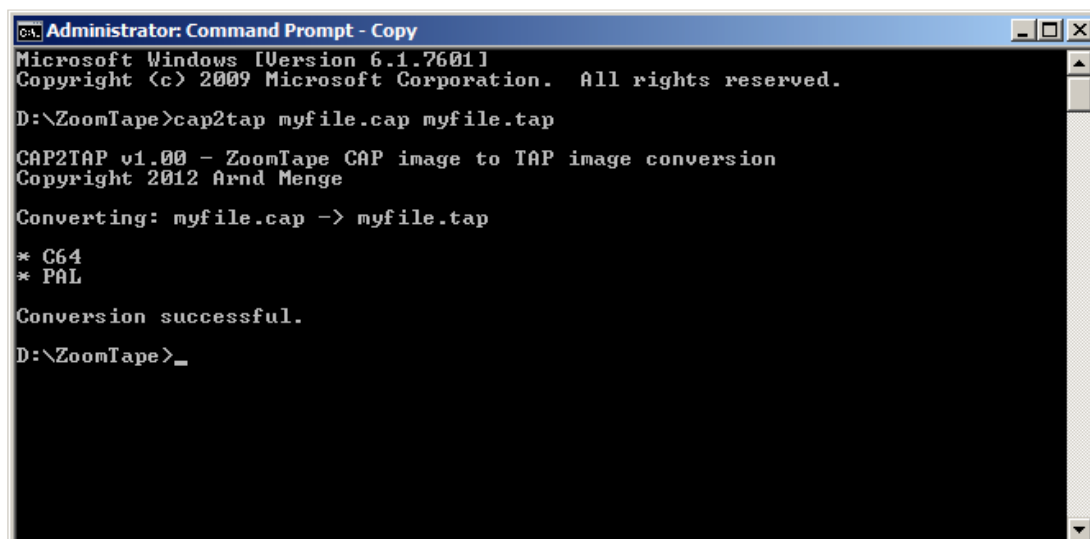
- cap2tap myfile.cap myfile.tap

The CAP tape image you specify as input.cap is converted to TAP format image output.tap.

Note: Spectrum 48k support is experimental, conversion from CAP to TAP might only work with tapes in standard ROM format.

Note 2: TAP v1 format is automatically used for C64 and VC20 tapes, TAP v2 is automatically used for C16 tapes.

Demonstration screenshot:



```
Administrator: Command Prompt - Copy
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

D:\ZoomTape>cap2tap myfile.cap myfile.tap

CAP2TAP v1.00 - ZoomTape CAP image to TAP image conversion
Copyright 2012 Arnd Menge

Converting: myfile.cap -> myfile.tap

* C64
* PAL

Conversion successful.

D:\ZoomTape>_
```

tap2cap.exe

General usage:

- tap2cap <input.tap> <output.cap>

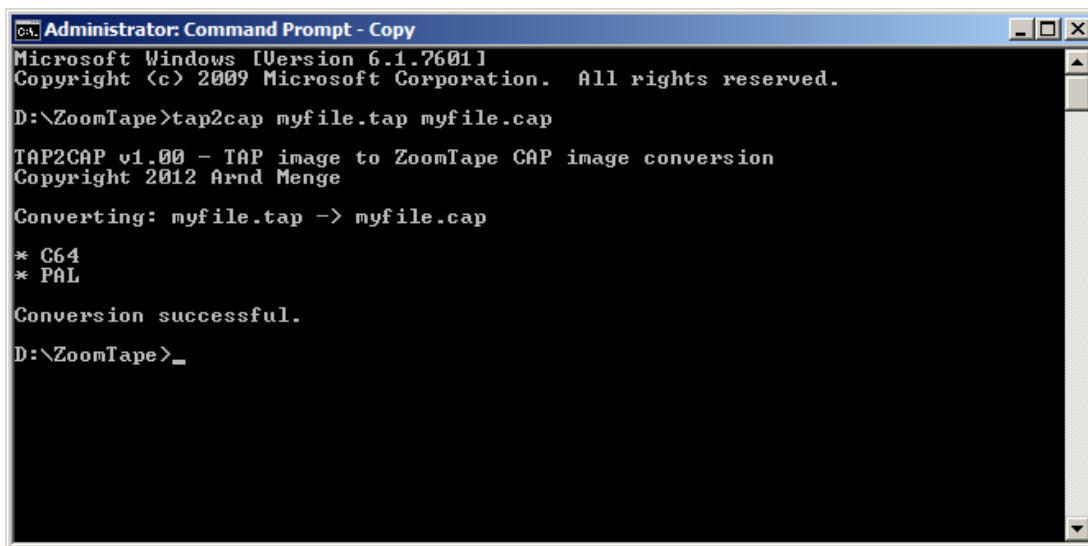
Example:

- tap2cap tap2cap myfile.tap myfile.cap

The TAP tape image you specify as input.tap is converted to CAP format image output.cap.

Note: Spectrum 48k support is experimental, conversion from TAP to CAP is not possible at the moment.

Demonstration screenshot:



```
Administrator: Command Prompt - Copy
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

D:\ZoomTape>tap2cap myfile.tap myfile.cap

TAP2CAP v1.00 - TAP image to ZoomTape CAP image conversion
Copyright 2012 Arnd Menge

Converting: myfile.tap -> myfile.cap

* C64
* PAL

Conversion successful.

D:\ZoomTape>_
```

tapcontrol.exe

General usage:

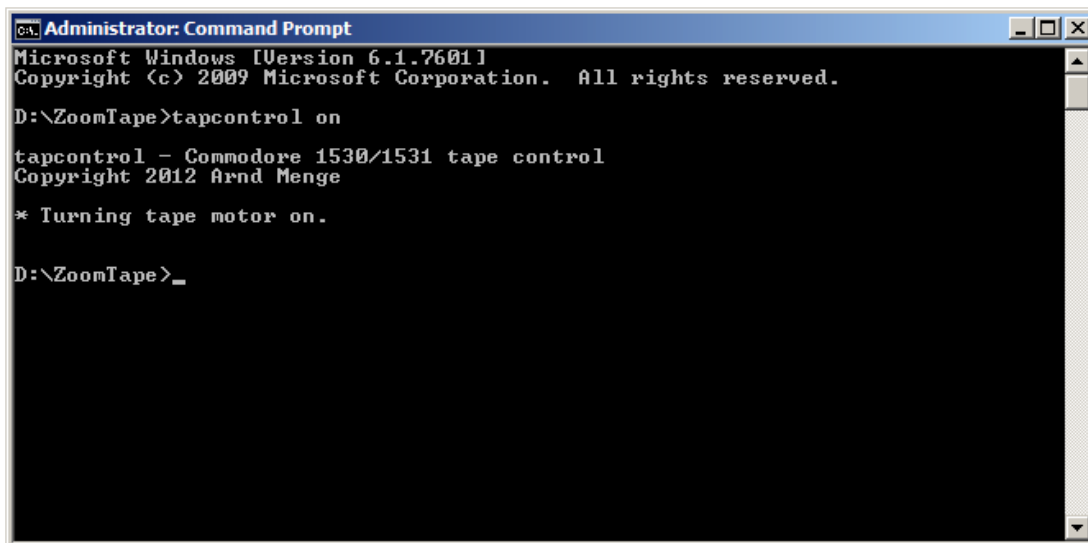
- tapcontrol <command>

Examples:

- tapcontrol on
- tapcontrol off

Turns the tape drive motor on or off. Tapcontrol does not work in standalone mode.

Demonstration screenshot #1:



```
Administrator: Command Prompt
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

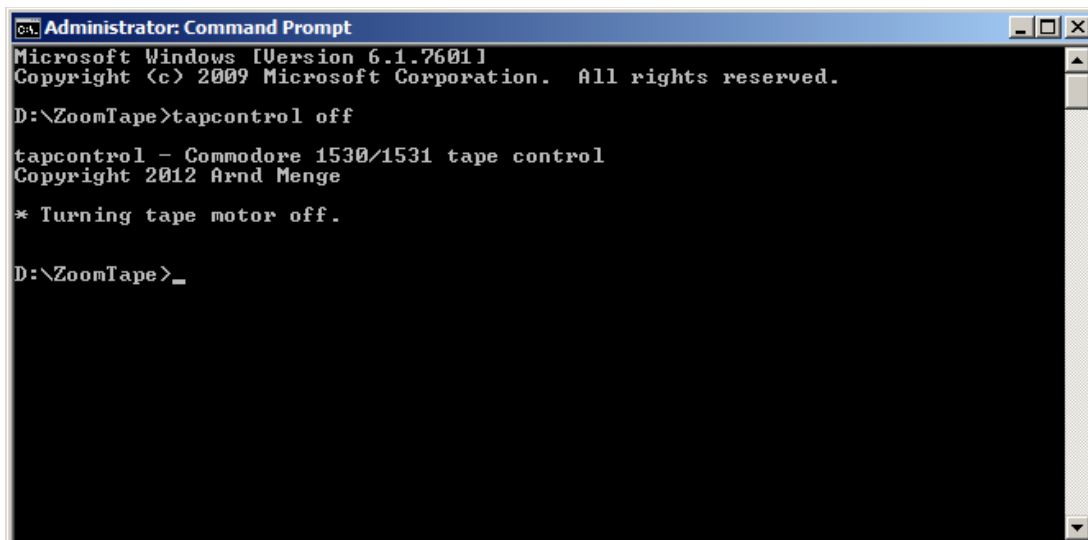
D:\ZoomTape>tapcontrol on

tapcontrol - Commodore 1530/1531 tape control
Copyright 2012 Arnd Menge

* Turning tape motor on.

D:\ZoomTape>_
```

Demonstration screenshot #2:



```
Administrator: Command Prompt
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

D:\ZoomTape>tapcontrol off

tapcontrol - Commodore 1530/1531 tape control
Copyright 2012 Arnd Menge

* Turning tape motor off.

D:\ZoomTape>_
```

tapview.exe

Tapview is a GUI application to visualize CAP image signals. Use this application to check the signal quality of your CAP images, to identify potential problems, and to find out if you need start/stop delays for tapwrite.

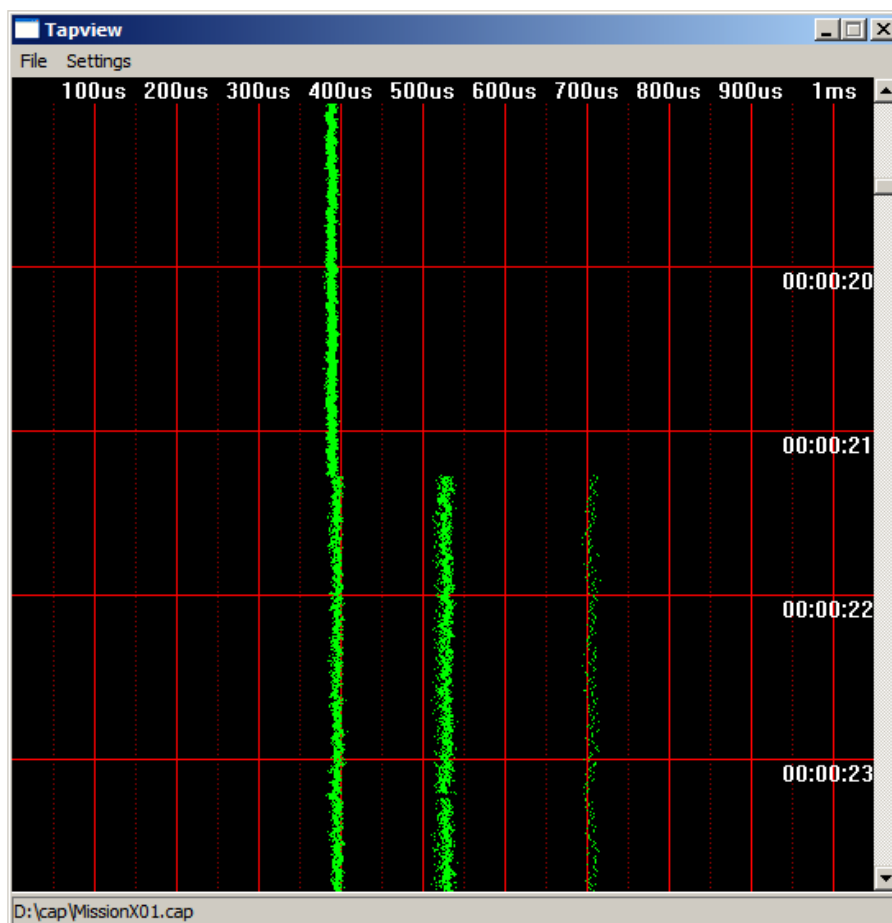
The horizontal axis shows the wave lengths in microseconds, the vertical axis shows the time codes as hours:minutes:seconds. Each horizontal line corresponds to 10ms (milliseconds). If a signal belongs into a certain 10ms interval its wave length will be displayed on the corresponding line. Signals on the same line with same wave length overwrite each other.

There are a few options in the application's menu.

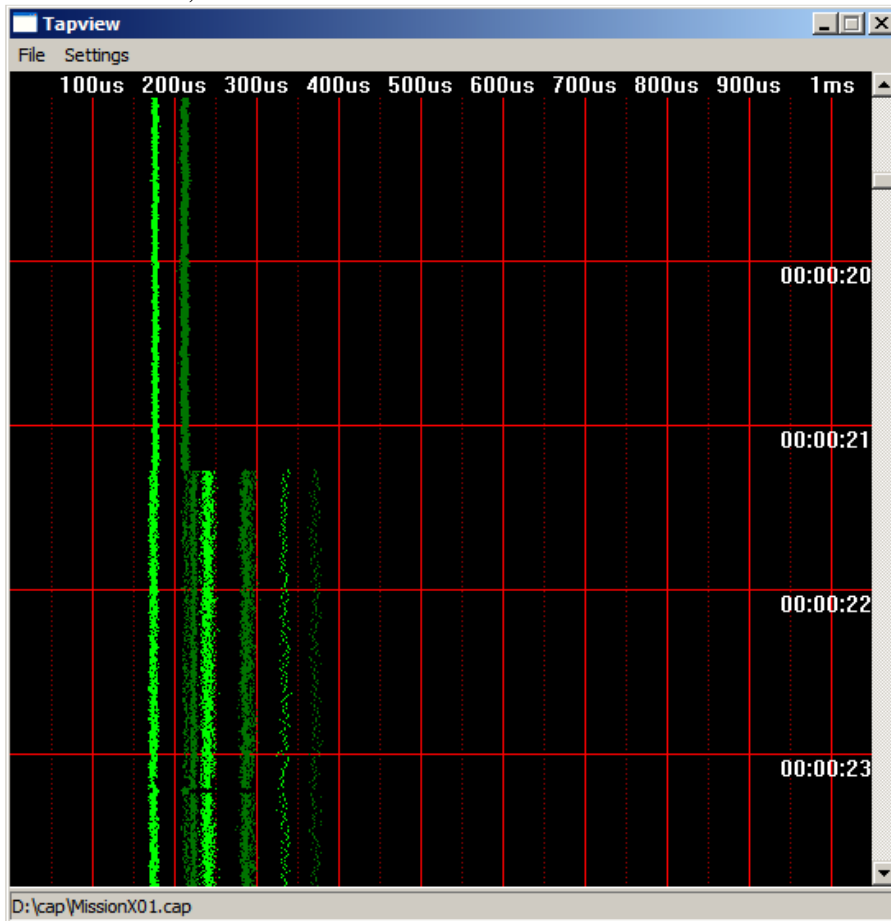
- Each signal consists of two half waves. The C64 recognizes only full wave lengths as signals. Select Show half waves to visualize the half waves, de-select to visualize the full waves.
- Full wave lengths are painted in light green color. When you choose to view half waves you can select First half wave in dark green to paint the first half waves in dark green color for better identification. The second half waves will be painted in light green color.
- Select Large window width and Large window height for better visibility on larger screens.
- Tapview's internal buffer is sufficient for visualizing a 1 hour long CAP image. Select a bigger buffer for longer CAP images. You will be informed if the selected buffer size is too small.

Demonstration screenshot #1.

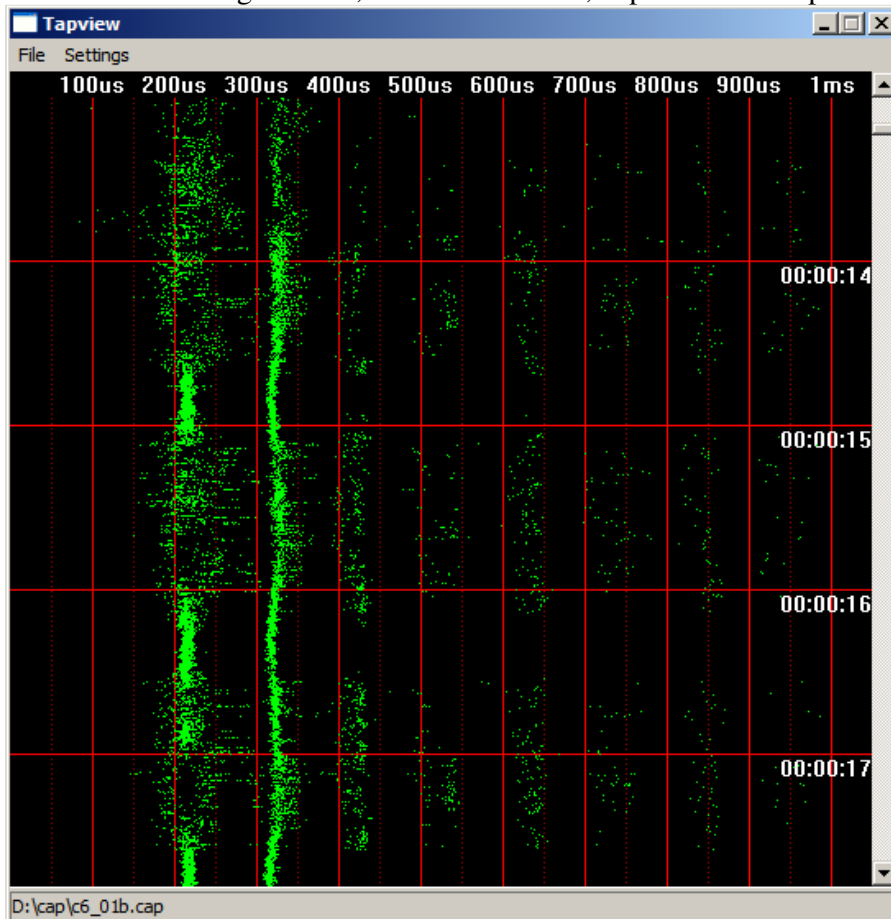
Clear thin vertical signal lines of 3 clearly separated wave lengths, full waves shown, good chances that the tape image is ok:



Demonstration screenshot #2.
Same as above, but half waves shown:

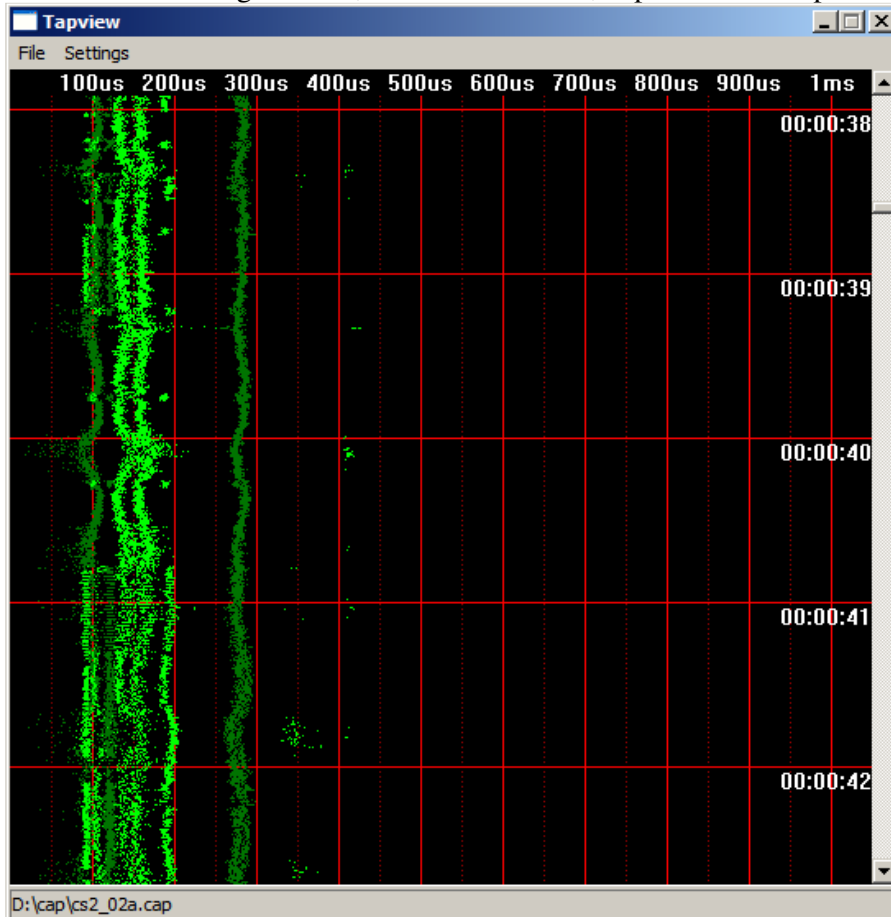


Demonstration screenshot #3.
No clear vertical signal lines, full waves shown, expect that the tape image does not work:



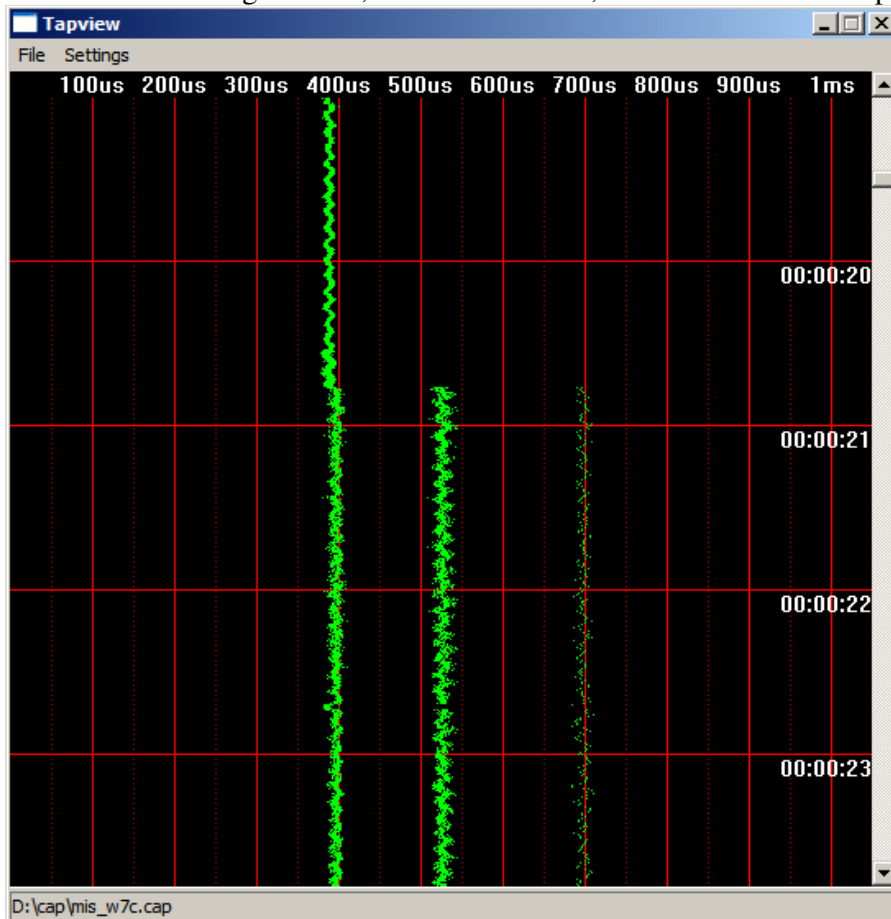
Demonstration screenshot #4.

No clear vertical signal lines, half waves shown, expect that the tape image does not work:



Demonstration screenshot #5.

Noise on vertical signal lines, full waves shown, undetermined if the tape image is ok:



Troubleshooting

Here are some steps to help you solve common problems. The ZoomTape is pretty reliable and simple to use, so there aren't many things that can go wrong. If you suspect a hardware problem, get help on the zoomfloppy-users mailing list or contact RETRO Innovations to make a return.

Observation	Problem	Things to try
tapread, tapwrite or tapcontrol return "Driver error."	OpenCBM is not correctly installed.	Please refer to ZoomFloppy's manual on OpenCBM installation. You may run "instcbm -r", then "instcbm xum1541", then try again.
ZoomTape's power LED does not turn on.	ZoomTape has no power.	Please make sure the original power supply unit is plugged into ZoomTape's power jack.
ZoomTape's motor LED does not turn on.	Power is not routed to the tape drive motor.	Tapread/tapwrite automatically turn on the motor when necessary. Try "tapcontrol on" to turn on the motor. Set a jumper to JP1 in standalone mode.
A tape image created/converted by tapread/cap2tap does not work.	Please consider that very old tapes from the 1980s might no longer work. The magnetic signal may decay gradually.	Use Tapview to get an idea of what could be wrong with the image. Try to fast-forward/rewind the tape and re-image a few times. Clean your tape drive. Try another tape drive. Recalibrate your tape drive. Keep your tape imaging equipment away from electromagnetic noise sources.
A tape written by tapwrite does not work.	The tape image works in emulator, but does not work on the real computer.	Use Tapview to get an idea of what could be wrong with the image. Your tape may be faulty, try a new tape. Clean your tape drive. Try another tape drive. Recalibrate your tape drive. Make an image of your non-working tape and try in emulator. Motor speed fluctuations might distort poor signal timings barely within recognizable thresholds just enough to be out of the thresholds. Use tape cleaners like "tapcleanfe" to realign the tape image. Keep your tape imaging equipment away from electromagnetic noise sources.
tapread returns "Error: Buffer full, use larger buffer size!"	Not enough memory for tape image storage.	Specify larger buffer size on tapread commandline.
cap2tap returns "Error: Unrecognized computer/video type."	CAP images of "-x custom/unknown" type cannot be converted.	Edit the CAP image and specify matching/valid computer/video types in the header. See CAP file format specification for details.
cap2tap: converted Spectrum48K TAP image does not work.	Spectrum48K support is experimental and might only work with tapes in standard ROM format at the moment.	-
tap2cap: Cannot convert into Spectrum48K CAP image format.	Spectrum48K support is experimental and does not allow conversion from TAP to CAP at the moment.	-
tap2cap returns "Error: Unsupported TAP file version."	Only standard TAP file format versions 0,1,2 are supported at the moment.	-
tap2cap returns "Error: Unrecognized TAP file signature."	An incompatible TAP image was specified.	Check if the TAP image works in an emulator.

Troubleshooting (continued)

When tape imaging make sure you have low CPU and USB load, a clean and calibrated tape drive, and clean and undamaged tapes.

Even the slightest damage to the magnetic tape media may introduce noise to the tape signal, which may render the read tape image or written tape non working. Repeatedly. Consider buying new tapes if you want to use tapwrite.

Tapread/tapwrite do not apply any normalizing/cleaning to the tape signals. Repeated re-writing and re-imaging successively disperses the signals from their respective original locations until they are out of bounds for recognition. This also applies to tape images with signals already barely or no longer within bounds for recognition.

Keep your tape imaging equipment away from electromagnetic noise sources.

Please do not connect any USB hubs when operating ZoomTape.

Support

If the troubleshooting section can't help you, there are mailing lists to contact.

OpenCBM mailing list for general questions about using the Windows driver software:

<https://lists.sourceforge.net/lists/listinfo/opencbm-user>

ZoomFloppy/ZoomTape users list. RETRO Innovations monitors this list and can handle hardware problems or other similar issues.

<http://googlegroups.com/group/zoomfloppy-users>

WARNINGS

Do not use a power supply unit other than that is bundled with the ZoomTape on purchase from RETRO Innovations. Using a not authorized power supply unit may damage your hardware and make ZoomTape's mounted heatsink get extremely hot and emit thermal stress.

Be careful of static electricity discharge when touching or plugging/unplugging any electronic equipment. Consider getting an enclosure for your ZoomTape board to better protect your hardware, but make sure the enclosure openings are large enough to permit appropriate heat exchange.

Do not plug or unplug your tape drive when the ZoomTape or ZoomFloppy are powered on. When the ZoomTape or ZoomFloppy are powered on, they could zap your tape drive if you connect or remove your tape drive. No "hot-plugging".

While operating ZoomTape only a single tape drive may be attached to the ZoomTape at any time, although there are two tape drive connectors. No floppy drives may be attached to the connected ZoomFloppy. Even unpowered drives may interfere with proper operation of other drives.

Keep your tape imaging equipment away from electromagnetic noise sources (such as mobile phones, etc.). While tape imaging is in progress do not switch power on/off of any nearby electric devices.

USB transmission is critical while reading/writing tapes. Keep your CPU and USB load at a minimum to ensure best tape imaging.

Do not connect any USB hubs when operating ZoomTape.

Proper power-on sequence

You can avoid unnecessary wear and/or damage to your hardware by following these instructions for starting up and shutting it down.

1. Start with ZoomTape, ZoomFloppy and tape drive disconnected, unpowered and unplugged from the PC's USB.
2. Attach the tape drive to ZoomTape and ZoomTape to ZoomFloppy.
3. Power on ZoomTape via power supply unit.
4. Plug in ZoomFloppy via USB.

Turn off the equipment via the same sequence in reverse, at least doing steps 4 and 3.

ZoomFloppy autodetects your attached tape drive at startup. Your tape drive will not be recognized if you attach it when ZoomFloppy is already powered up. No "hot-plugging".

If ZoomFloppy autodetected an attached tape drive at startup disk drive operations are no longer permitted for this session.

Credits

- Arnd Menge designed the ZoomTape. He designed the PCB layout, built the prototype boards and wrote the ZoomFloppy firmware extensions, OpenCBM extensions, user applications, and this manual.
- Nate Lawson for designing the ZoomFloppy.
- Jim Brain at RETRO Innovations did the manufacturing, hardware sales and support.
- Spiro Trikaliotis for maintaining OpenCBM.
- Markus Brenner for mtap/ptap under MS-DOS.
- Dean Camera for the very useful LUFA AVR USB library.

--- THIS IS A DRAFT VERSION ---