

TURGEN SYSTEM DOCUMENTATION

version 8.4.6

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Contents

I	TURGEN SYSTEM	7
1	Introduction	7
1.1	Primary Functionality	7
1.2	Auxiliary Functionality	7
1.3	Support for Standard Tape Records	7
1.4	Hardware that can be used	7
1.5	Target Audience	7
1.6	Program Characteristics	7
1.7	System Requirements	7
1.8	Abbreviations	8
1.9	Glossary	8
1.10	Similar Utilities	9
2	Distribution and Installation	9
2.1	Preliminary Operations	9
2.2	Distribution	9
2.3	Installation and Directories	9
3	Operations Guide	9
3.1	Starting TURGEN SYSTEM	9
3.2	Program Controls	10
3.3	Conversion of Files	11
3.3.1	Playlist Items	11
3.3.2	Working with Playlist	11
3.3.3	Playlist Item Manipulation	11
3.4	Wizard for Binary Files	12
3.5	Output	12
3.5.1	Output of Electric Signal into WAVE File	12
3.5.2	Output of Electric Signal to Sound Card.	13
3.5.3	Output of Tape Image	13
3.6	Input/Output matrix	13
3.7	Pulse Corrections	13
3.7.1	Motivation	13
3.7.2	Permanent Pulse Corrections	13
3.7.3	Immediate Pulse Corrections	13
3.8	Silence Lists	14
3.8.1	Overview	14
3.8.2	Silence List Syntax	14
3.8.3	Examples	14
4	Program Configuration Facility	14
4.1	Changing Configuration	14
4.2	General Configuration Entries	14
4.3	Output of Electric Signal to Sound Card	15
4.4	Output of Electric Signal into WAVE File	15
4.5	Output of Tape Images	16

5	Advanced Settings	16
5.1	Active Plugins	16
5.2	Repository of Pulses	16
6	Tools	16
6.1	Merging Segments of Binary Files	16
6.1.1	Introduction	16
6.1.2	Merging Segments Step by Step	17
6.2	Turbo Decoder	17
6.2.1	Overview	17
6.2.2	Preparing the Decoder	18
6.2.3	Decoding Files	18
6.2.4	Monitor Mode	19
6.3	Embedding Tokenized BASIC Files to Binary Files	19
6.3.1	Motivation	19
6.3.2	Operations	19
6.4	Tape Image Extractor	20
6.4.1	Operations	20
7	Hardware that Can Be Used with TURGEN SYSTEM	21
7.1	Data Recorders and Compact Cassettes	21
7.2	Cassette Adapters	21
7.3	MEGA-CD Interface (CD-LINK)	21
7.4	SIO2PC and ATART	21
7.5	Loading Binary Files with Replacement Devices	21
8	Postprocessing	22
8.1	Postprocessing of WAVE Files	22
8.2	Postprocessing of Tape Images	22
8.3	Examples	22
9	Data Transfer via Serial Port in Collaboration with CAS COM Utility	22
9.1	Introduction	22
9.2	Command Line Considerations	23
10	Hints and Tips	24
II	BUILT-IN PLUGINS	24
11	Turbo 2000 and Super Turbo	24
11.1	Characteristics	24
11.2	Conversion types	25
11.3	Header Block	25
11.4	Inserting Silence After INIT Segments	25
11.5	Prepending Universal Turbo Loader	25
11.6	Configuration Entries	26
12	Turbo 2000 - Kilobyte Blocks	26
12.1	Characteristics	26
12.2	User Interface	26
12.3	Binary Loaders	27
12.4	Prepending Universal Turbo Loader	27
12.5	Configuration Entries	27

13 B-TAPE	28
13.1 Characteristics	28
13.2 User Interface	28
13.3 Binary Loaders	28
13.4 Prepending Universal Turbo Loader	29
13.5 Configuration Entries	29
14 KSO Turbo 2000	29
14.1 Characteristics	29
14.2 User Interface	30
14.3 Configuration Entries	30
15 Turbo Blizzard	30
15.1 Characteristics	30
15.2 User Interface	30
15.3 Configuration Entries	31
16 Turbo ROM	31
16.1 Characteristics	31
16.2 User Interface	32
16.3 Conversion of Turbo ROM Compatible Binary Files	32
16.4 Conversion of Binary Files	32
16.4.1 Processing	32
16.4.2 User Interface	32
16.5 Conversion of Tokenized BASIC Files	32
16.6 Prepending Loaders	32
16.7 Configuration Entries	32
17 Atari Super Turbo	33
17.1 Characteristics	33
17.2 User Interface	33
17.3 Configuration Entries	34
18 Hard Turbo	34
18.1 Characteristics	34
18.2 User Interface	34
18.3 HTBL+ Loader	35
18.4 Configuration Entries	35
19 Lower Silesia Turbo 2000	35
19.1 Characteristics	35
19.2 Conversion Types	36
19.3 User Interface	36
19.4 Configuration Entries	36
20 Standard	37
20.1 Characteristics	37
20.2 User Interface	37
20.3 Conversion of Monolithic Binary Files	38
20.4 Conversion of Segmented Binary Files	38
20.4.1 Processing	38
20.4.2 User Interface	38
20.5 Configuration entries	38

21 Tape Image	38
21.1 Turbo Records	38
21.2 Standard Tape Records	38
 III TURBO SYSTEMS	 39
22 Introduction	39
23 Information encoding	39
24 Turbo Systems from Former Czechoslovakia	39
24.1 Common Information	39
24.1.1 Switching Data Recorder to Turbo Mode	39
24.1.2 Single Purpose or CIO	39
24.1.3 Pilot Tone and Data Separation	39
24.2 Turbo 2000	40
24.2.1 Description	40
24.2.2 Header block	40
24.2.3 Data block	40
24.2.4 Timing	40
24.2.5 Loaders	40
24.3 Super Turbo	41
24.3.1 Description	41
24.3.2 Header block	41
24.3.3 Data block	41
24.3.4 Timing	41
24.3.5 Loaders	41
24.4 Turbo 2000 - kilobyte blocks	42
24.4.1 Description	42
24.4.2 Header block	42
24.4.3 Data blocks	42
24.4.4 Timing	42
24.4.5 Loaders	42
24.5 Turbo Tape	43
24.5.1 Description	43
24.5.2 Tape modes	43
24.5.3 Structure of the blocks	43
24.5.4 Timing	43
24.6 B-TAPE	43
24.6.1 Description	43
24.6.2 Tape modes	44
24.6.3 Structure of the blocks	44
24.6.4 Timing	44
24.6.5 Notes	44
 25 Turbo systems from Poland	 45
25.1 KSO Turbo 2000 and Turbo 2000F	45
25.1.1 Description	45
25.1.2 Header block	45
25.1.3 Data block	45

25.1.4	Timing	45
25.2	Atari Super Turbo (AST)	45
25.2.1	Description	45
25.2.2	AST File Format	46
25.2.3	BUT File Format	46
25.2.4	AST Header Block	46
25.2.5	BUT Loader Header Block	46
25.2.6	BUT Loader Data Block	46
25.2.7	AST and BUT Data Block	46
25.2.8	BUT Termination Segment Header	46
25.2.9	Timing	47
25.3	Turbo Blizzard	47
25.3.1	Description	47
25.3.2	Header block	47
25.3.3	Data block	47
25.3.4	Timing	47
25.4	Turbo ROM	47
25.4.1	Description	47
25.4.2	Header Block for Binary Files	48
25.4.3	Data Block for Binary Files	48
25.4.4	Header block for BASIC files	48
25.4.5	Data Block for BASIC Files	49
25.4.6	Timing	49
25.5	Hard Turbo	49
25.5.1	Description	49
25.5.2	Main Header Block	49
25.5.3	Segment Header Block	49
25.5.4	Segment Data Block	49
25.5.5	Timing	50
25.6	Lower Silesia Turbo 2000	50
25.6.1	Description	50
25.6.2	Auto Turbo Format	50
25.6.3	Unknown Exterminator Unprotected Binary Format and Protected Binary Format (UE UBF and UE PBF)	50
25.6.4	Auto Turbo Header block	50
25.6.5	Auto Turbo Data block	50
25.6.6	UE PBF Dummy RUN block	51
25.6.7	UE UBF and UE PBF Segment Header Block	51
25.6.8	UE UBF and UE PBF Segment Data Block	51
25.6.9	UE UBF and UE PBF Termination Segment Header	51
25.6.10	Timing	51

Part I

TURGEN SYSTEM

1 Introduction

1.1 Primary Functionality

TURGEN SYSTEM converts files to various turbo systems and also to standard tape records.

Output of the program is a WAVE file, an electric signal on the output of the sound card, or a tape image.

TURGEN SYSTEM has special support for conversion of segmented binary files which includes a wizard and a set of binary loaders.

1.2 Auxiliary Functionality

- Turbo decoder that can be used to retrieve information from tapes
- Reading of tape images
- Data transfer via serial port in collaboration with CAS COM utility
- Tool for merging segments of binary files
- Tool for embedding tokenized BASIC files to monolithic binary files
- Tape image extractor tool that extracts data from tape images

1.3 Support for Standard Tape Records

Standard tape records are fully supported. Tape images with baud, data, and fsk chunks can be read by the Tape image plugin. Monolithic binary files, segmented binary files, BASIC files, and plain data files can be converted to standard tape records by the Standard plugin. Refer to sections 20 and 21.

1.4 Hardware that can be used

Data recorders with or without turbo upgrades, data recorder replacement devices, MEGA-CD interface (CD-LINK), SIO2PC, ATART.

Important information. If you are using devices other than data recorder and compact cassettes, please read section 7.5 that contains vital information about how to use such devices. Also read section 3.8.

1.5 Target Audience

Owners of Atari 8-bit computers who use data recorders or replacement devices.

1.6 Program Characteristics

TURGEN SYSTEM is written in Java™ 2 programming language and it is a free software distributed under the terms of GNU General Public License, version 2.

1.7 System Requirements

- Java Runtime Environment 1.5.0 or newer
- Solaris, Microsoft Windows 98/2000/ME/XP/Vista/7/8, GNU/Linux, Mac OS

1.8 Abbreviations

TS. TURGEN SYSTEM.

JRE. Java Runtime Environment.

JDK. Java Development Kit.

1.9 Glossary

Binary file. File primarily designed to accommodate a *program* for Atari 8-bit computers. Binary file has a well-defined internal structure.

Every binary file starts with a two-byte header (or eye-catcher). Both bytes have value of 255.

Binary file consist of data blocks called *segments*. A segment is a block of data that has a *segment header*. The segment header is four bytes long and accommodates two 16-bit addresses (start address and end address). These two addresses determine where to place the segment when it is being loaded from a peripheral device into memory.

There are four types of segments. All of them are described in table 1.

Segment header	Segment description
736, 737	RUN segment. The segment is always 2 bytes long. These two bytes accommodate an address that specifies where to jump after all segments of a given binary file are loaded.
738, 739	INIT segment. The segment is always 2 bytes long. These two bytes accommodate an address of a subroutine that is executed immediately after the INIT segment is loaded.
736, 739	RUNINIT segment. Combination of the previous jump segments. 4 Bytes long.
Other	DATA segment. The segment accommodates executable code or data.

Table 1: Segments

Monolithic binary file. Binary file with a very simple structure. It consists of exactly one data segment and at most one RUN segment.

Segmented binary file. Binary file that is not monolithic.

Binary loader. Program, or routine (usually part of an operating system) that loads and executes binary files.

Binary load. Name for the process of loading and running of a binary file. This process is performed by a binary loader.

Cassette recorder. Consumer electronics device designed to read or write electric signal to or from compact cassettes.

Data recorder. Device designed to read or write signal to or from compact cassettes, specially designed to be connected to computers, for example Atari XC-12.

Program directory. Directory or folder where TURGEN SYSTEM is installed to. Special symbol <TSDIR> is also used to reference this directory.

Configuration directory. Directory or folder where TURGEN SYSTEM stores user configuration files. Special symbol <CFGDIR> is also used to reference this directory.

Java home directory. Directory or folder where JRE (or JDK) resides. Special symbol <JAVAHOME> is also used to reference this directory.

Turbo system. This term denominates a system designed to speed up data transfer of the original Atari data recorder. A typical turbo system consist of three parts: 1. Hardware modification of data recorder, 2. Software exploiting such hardware modification, 3. File format. There is not necessarily 1:1:1 relation. For one hardware modification of data recorder, there can exist more software or more file formats.

TURGEN SYSTEM restricts this term to systems that use PWM (pulse width modulation) to encode data. Some examples of turbo systems are Turbo 2000 or Turbo Blizzard. Example of system that is not considered to be turbo system is the IRON TURBO.

1.10 Similar Utilities

Turgen System provides similar functionality as the following utilities: A8CAS, a8cas-util, CAS2WAV, XEX2CAS, and ATART.

2 Distribution and Installation

2.1 Preliminary Operations

Before installing TURGEN SYSTEM, do install the Java Runtime Environment. Download JRE from the following address: <http://java.com/en/download/index.jsp>. It is recommended to download the newest available version of JRE for your operating system.

2.2 Distribution

Program is distributed in two forms:

1. Compressed tar files. These files are devoted for users that do not use supported versions of Microsoft Windows or those who want to avoid overhead of automated installers for some reasons.
2. Automated installer for Microsoft Windows. This installer provides convenience and creates shortcuts in the Start menu or on the desktop. Shortcuts won't be created if JRE (or JDK) is not installed.

2.3 Installation and Directories

To install TURGEN SYSTEM, decompress the compressed tar file or run the automated installer. During installation, the program directory is created and populated with files.

The program directory contains all necessary files required to run TURGEN SYSTEM. TS never writes to this directory; it is recommended to set read-only access to the directory in order to provide security.

The configuration directory is created by TS when needed (usually during the first run). Its location is operating system dependent and TS requires read-write access for full functionality, however it will still work with limitations even though read-write access is not granted. To display name of this directory, select *About* item from the *Turgen* menu.

3 Operations Guide

3.1 Starting TURGEN SYSTEM

The Hard Way

Program code of the TURGEN SYSTEM is located in the `turgen.jar` file. To run TURGEN SYSTEM, run Java launcher and specify that the program code is in the `turgen.jar` file, using the following commands.

<JAVAHOME>/bin/java -jar <TSDIR>/turgen.jar on Unix-like systems or

<JAVAHOME>\bin\javaw.exe -jar <TSDIR>\turgen.jar under Microsoft Windows.

Microsoft Windows

Use shortcuts created by the automated installer or double-click the `turgen.jar` file icon.

Other Operating Systems

Create launchers or shortcuts using means provided by your desktop environment.

Command Line Parameters

One command line parameter is accepted - a file that accommodates a playlist.

Log File

Exceptions, traces or other important diagnostic information is stored into the `turgen.log` file located in the configuration directory. This file is recycled when it exceeds size of 4 MB.

3.2 Program Controls

Main Menu and Playlist

The main menu is located on the top of the program window. Almost all functions are accessible from the main menu.

In the middle of the program window, there is *playlist* that accommodates information what files are to be converted and how they will be converted.

Main Control Buttons

Under the playlist, there is a panel, where the *main control buttons* are located. The most used functions of TS are reachable using these buttons. Every button has its icon and name. The buttons are depicted in table 2.











Icon	Name	Icon	Name
	Add item to playlist		Move 1 playlist item up
	Edit selected playlist item		Move 1 playlist item down
	Remove selected playlist items		Generate WAVE file
	Select all playlist items		Generate AUDIO directly
	Generate tape image		Wizard for binary files

Table 2: Main control buttons

Progress Monitoring Panel

This panel is located in the bottom part of the program window. Conversions of files can be monitored or stopped here. At the very bottom of the program window, there is a status bar.

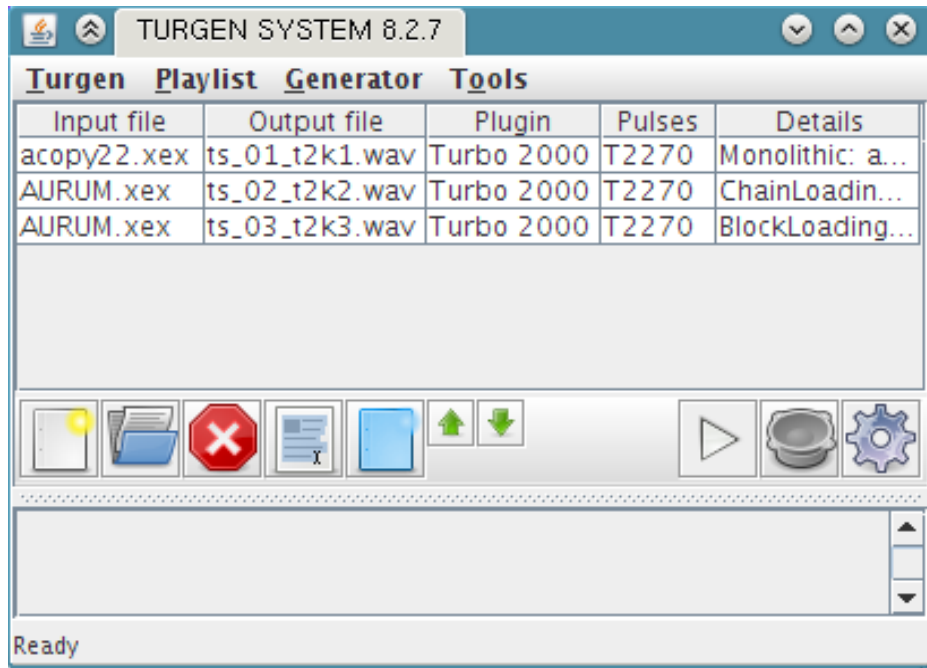


Figure 1: Program window

3.3 Conversion of Files

3.3.1 Playlist Items

In order to convert a file, TURGEN SYSTEM requires information about such conversion which includes input file name, input and output format, output file name, what loader to prepend and various other parameters. Such information is accommodated in *playlist items*. Playlist items are elements of the *playlist*.

3.3.2 Working with Playlist

To work with playlist, use the main control buttons or the items from the *Playlist* menu.

To add a playlist item to the playlist, click the *Add item to playlist* main control button. To edit playlist items, click the *Edit selected playlist item* main control button. To remove selected playlist items, click the *Remove selected playlist items* main control button.

To select playlist items, use keyboard or mouse. To select all playlist items, click *Select all playlist items* main control button.

To move single playlist items use *Move 1 playlist item up* and *Move 1 playlist item down* buttons.

To load or save a playlist, use the *Load* and *Save* items from the *Playlist* menu.

3.3.3 Playlist Item Manipulation

TURGEN SYSTEM provides a dialog for playlist item manipulation which is depicted on figure 2.

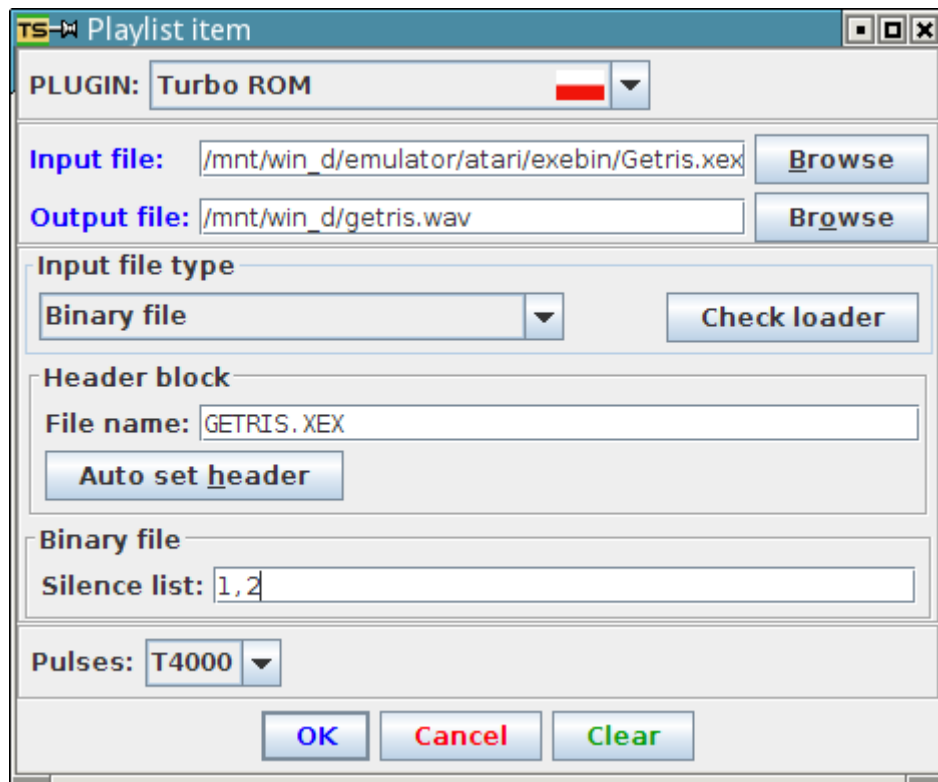


Figure 2: Manipulating playlist item

Use the Combo box *PLUGIN* to choose plugin that will be used for conversion. National flags can be used to distinguish from where a particular turbo system comes from.

In the top part of the dialog, there is a common panel that is used to set input and output file. To display a dialog with information about input file, click the *Input file* label. To fill the output file text field automatically, click the *Output file* label. To display a file chooser dialog, click the *Browse* buttons.

In the middle part of the dialog, there are controls specific for the selected plugin.

Use buttons at the bottom to commit or cancel playlist item manipulation. Click *Clear* button to reset controls in the dialog.

3.4 Wizard for Binary Files

Wizard for binary files provides convenience when converting binary files.

To start the wizard, click the *Wizard for binary files* main control button.

In the first step, specify a binary file that you want to convert and what are the capabilities of your data recorder. In the second step, choose one of the conversion methods offered by the wizard, output file name and pulses.

Offered conversion methods are ordered by the number of pilot tones or leaders. The wizard also checks (finitely of course) whether the binary file will destroy a built-in binary loader that will be prepended.

3.5 Output

3.5.1 Output of Electric Signal into WAVE File

To output electric signal into a WAVE file, select at least one playlist item and click the *Generate WAVE file* main control button. A separate thread for each selected playlist item is created. These threads run in parallel and it is possible to stop them using the *Stop* buttons that will appear in the progress monitoring panel. The output files are overwritten without a warning.

3.5.2 Output of Electric Signal to Sound Card.

To output electric signal to the sound card, select at least one playlist item and click the *Generate AUDIO directly* main control button. Playlist items are processed sequentially. It is possible to stop the output using *Stop* and *Stop all* buttons that will appear in the progress monitoring panel. To resume output, click the *Resume* button.

3.5.3 Output of Tape Image

To output a tape image, select at least one playlist item and click the *Generate tape image* main control button. Playlist items are processed serially. The output files are overwritten without a warning. The format of tape image can be configured using Program configuration facility described in section 4.

Please note that tape images with *pwmX* and especially *trXX* chunks are not widely supported by available utilities or devices.

3.6 Input/Output matrix

Conversion capabilities of Turgen System are enumerated in the following table.

Input	Wave file	Sound card	Tape Image with trXX chunks	Tape image with pwmX chunks
Regular file	YES	YES	YES	YES
Binary file	YES	YES	YES	YES
Tape image (trXX chunks)	YES	YES	Passed through	YES
Tape image (pwmX chunks)	YES	YES	NO	Passed through
Tape image (baud, fsk chunks)	YES	YES	Passed through	Passed through

3.7 Pulse Corrections

3.7.1 Motivation

Turgen System has a repository of pulses for all supported turbo systems (see 5.2). The values in the repository have been tested using patched Atari800 emulator provided by the A8CAS project. However, users of TS already reported minor problems when using real hardware. In light of this problems, an ability to comfortably correct the pulses is highly desired.

3.7.2 Permanent Pulse Corrections

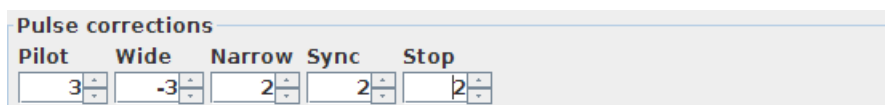
To make permanent corrections of pulses, use the Program configuration facility. Plugins that support permanent pulse corrections are KSO Turbo 2000, Atari Super Turbo, Turbo ROM, and Turbo Blizzard.

3.7.3 Immediate Pulse Corrections

You can temporarily correct the pulses for all plugins. Select the *Immediate pulse corrections* item from the *Generator* menu. A special panel appears.

Use controls on the special panel to adjust durations of the pulses. You can make the pulses narrower (negative values) or wider (positive values). One unit represents 1/44100 s.

Note that immediate pulse corrections always override permanent ones.



The screenshot shows a window titled "Pulse corrections". Inside, there are five columns with headers: "Pilot", "Wide", "Narrow", "Sync", and "Stop". Each header has a corresponding input field with a numeric value and up/down arrow buttons. The values are: Pilot (3), Wide (-3), Narrow (2), Sync (2), and Stop (2).

Figure 3: Pulse Corrections

3.8 Silence Lists

3.8.1 Overview

The silence lists allow comfortable usage of devices other than data recorder and compact cassettes (refer to section 7.5).

The silence lists allow the following:

- Insert silence of defined duration after a block that contains INIT segments
- Pause output of electric signal to sound card after a block that contains INIT segments

The silence lists are part of the playlist items (refer to section 3.3.1).

3.8.2 Silence List Syntax

A silence list consists of silence specifications (SPECs) separated by commas:

`SILENCE_LIST:=<SPEC>,<SPEC>,...,<SPEC>`

A silence specification is a number followed by optional P suffix or just a P suffix which is an equivalent of 1P syntax:

`SPEC:=n[P] | P`

where n is a number of seconds of silence that will be generated. P suffix indicates that output of electric signal to sound card will be paused.

3.8.3 Examples

Silence List	Explanation
1,3,0,4	1 second of silence after 1st INIT segment 3 seconds of silence after 2nd INIT segment No silence after 3rd INIT segment 4 seconds of silence after 4th INIT segment
3,2P,P	3 seconds of silence after 1st INIT segment 2 seconds of silence after 2nd INIT segment, output of electric signal to sound card will be paused 1 second of silence after 3rd INIT segment, output of electric signal to sound card will be paused

4 Program Configuration Facility

The Program configuration facility provides various program modules with configuration capabilities in a uniform way. Program configuration consists of *configuration entries* that are grouped in *configuration classes*.

4.1 Changing Configuration

To change program configuration, use the *Preferences* dialog. To make configuration changes permanent, save the configuration by selecting the *Save preferences* menu item from the *Tools* menu, or click the *OK & Save* button when exiting the dialog.

4.2 General Configuration Entries

TURGEN SYSTEM/GUI Look and feel

Look and feel of the user interface, fully qualified class name. If the entry is empty, default look and feel is used.

Standard looks and feels:

`javax.swing.plaf.metal.MetalLookAndFeel` (all platforms, default)

`com.sun.java.swing.plaf.motif.MotifLookAndFeel` (all platforms)

`com.sun.java.swing.plaf.windows.WindowsLookAndFeel` (Microsoft Windows only)
`com.sun.java.swing.plaf.gtk.GTKLookAndFeel` (only when GTK+ 2.2 or newer is installed)
`com.sun.java.swing.plaf.mac.MacLookAndFeel` (only Mac, untested)
`com.sun.java.swing.plaf.nimbus.NimbusLookAndFeel` (new since JDK 1.6 update 10)
TURGEN SYSTEM/favorite output directory
Favorite directory for output files.

4.3 Output of Electric Signal to Sound Card

Audio output/Silence between files

Length of silence in milliseconds generated between playlist items.

Audio generator/Amplitude

Amplitude of the signal. 0-100%. It is not recommended to set the value too low.

Audio generator/Channels

Number of channels.

Audio generator/Bits per sample

Number of bits per one sample.

Audio generator/Signed samples

Indicates whether to use signed samples.

Audio generator/Initial silence

Length of silence generated after sound card initialization, unit is 0.1 of second. This may be needed, because the very first data sent to the sound card can result in unwanted signals.

Audio generator/Terminal silence

Length of silence that will terminate the output. This may be needed, because the very last data sent to the sound card can be truncated.

Audio generator/Buffer size

Size of the buffer for data being sent to the sound card. Increasing this value can help when there are under runs and output from the sound card is repeatedly interrupted.

Audio generator/Signal in right channel only

If the number of channel is set to two, signal will be generated to the right channel only.

Audio generator/Do not modulate standard records

If set to true, standard tape records will be generated without modulation. The resulting signal will be the same as it would be on the DATA-IN pin of the SIO port. This option should allow to pass standard tape records through turbo decoder circuitry.

Audio generator/Use double buffering

If set to true, an internal buffer is used to store the electric signal before it is sent to the sound card. This reduces number of round-trips between TS and operating system's native sound facilities.

Audio generator/Use harmonic pulses

If set to true, harmonic pulses are generated instead of rectangular pulses. This can be useful when the electric signal is passed through a device that distorts signal with steep edges. Please note that harmonic pulses probably wont work with transfer speed higher than 3000 bd.

4.4 Output of Electric Signal into WAVE File

WAVE generator/Amplitude

Amplitude of the signal. 0-100%. It is not recommended to set the value too low.

WAVE generator/Channels

Number of channels.

WAVE generator/Bits per sample

Number of bits per one sample.

WAVE generator/Postprocessing command

Command line for postprocessing. For more information refer to section 8.1.

WAVE generator/Change extension to .wav

Extension of output files will be changed to .wav in intelligent way if set to true.

WAVE generator/Signal in right channel only

If the number of channel is set to two, signal will be generated to the right channel only.

WAVE generator/Do not modulate standard records

If set to true, standard tape records will be generated without modulation. The resulting signal will be the same as it would be on the DATA-IN pin of the SIO port. This option should allow to pass standard tape records through turbo decoder circuitry.

WAVE generator/Use harmonic pulses

If set to true, harmonic pulses are generated instead of rectangular pulses. This can be useful when the electric signal is passed through a device that distorts signal with steep edges. Please note that harmonic pulses probably won't work with transfer speed higher than 3000 bd.

4.5 Output of Tape Images

Tape image output/Change extension to .cas

Extension of output files will be changed to .cas in intelligent way if set to true.

Tape image generator/Postprocessing command

Command line for postprocessing. For more information refer to section 8.2.

Tape image generator/Auto create temporary files

If the output file is not specified and this entry is set to true, temporary file is created automatically. This is useful for postprocessing.

Tape image generator/Tape image chunks

This entry is used to specify, what type of chunks will be placed into generated tape images. trXX style chunks or pwmX can be specified. trXX style chunks are used by CASCOS , pwmX style chunks are used by A8CAS.

5 Advanced Settings

5.1 Active Plugins

The list of plugins that will be loaded is stored in the `plugins.list` file. To disable a plugin, remove or comment-out (using the # character) the corresponding line. To change the order of the plugins (that is what users from Poland may want to do), change order of the lines.

Note: Some plugins process trXX tape image chunks. If a plugin is disabled, given trXX tape image chunk cannot be processed.

5.2 Repository of Pulses

The repository of pulses is stored in `pulses/pulses.list` file. Repository can be modified, directions are present in the file itself as comments. It is not recommended to modify the repository without serious reasons. Changes take effect after TS is restarted.

6 Tools

6.1 Merging Segments of Binary Files

6.1.1 Introduction

TURGEN SYSTEM is equipped with a tool that merges segments of binary files into one segment and adds extra code that emulates the effect of the INIT segments. This allows to convert segmented binary files that meet certain conditions to monolithic binary files.

This tool was created in early times of TURGEN SYSTEM in order to partially cope with limitations of Czechoslovak Turbo 2000 and Super Turbo turbo systems.

Conditions that the segmented binary files must meet are the following: 1. Data segments must not overlap, 2. Routines called by the jump segments must work even when all data segments are already loaded, 3. There must be place for code that emulates effect of the INIT segments. Usually, the only way how to test this conditions is to run the resulting monolithic binary file in some emulator. It should be noted that capabilities of this tool must be considered limited.

6.1.2 Merging Segments Step by Step

Display the dialog for merging segments of binary file by selecting item *Merge segments of binary file* from the *Tools* menu.

Fill-in the *Input file* text field and press the *Analyze* button. The list of segments will be filled-in and you will be able to check whether the first condition is met. Then fill-in the *Output file* text field and specify address of the replacement code that will emulate the effect of jump segments. The replacement code is needed only when there are INIT or RUNINIT segments in the binary file.

Click the *Merge !* button to merge the segments and create the output binary file. Test the created binary file using some emulator.

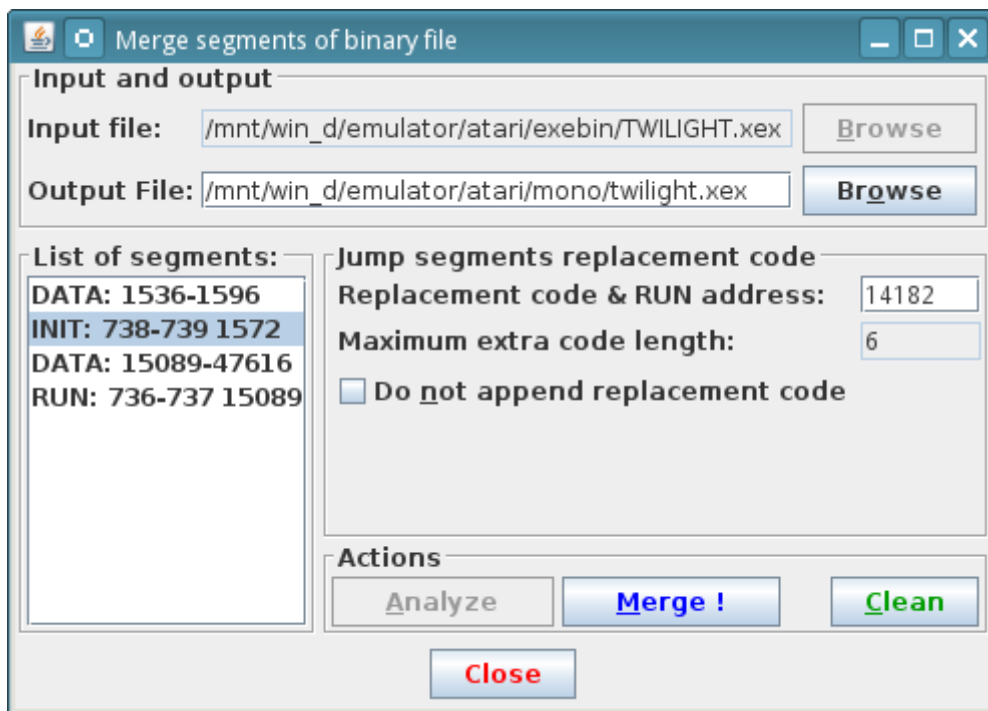


Figure 4: Merging segments of binary file

6.2 Turbo Decoder

6.2.1 Overview

Turbo decoder is a tool designed to retrieve data from compact cassettes. The decoding algorithm is a simple Java rewrite of turbo loaders from assembler 6502.

The electric signal can be read from WAVE files. When creating WAVE files, it is recommended to set the cassette recorder to get maximum signal amplitude. The WAVE file must be in the following format: PCM, 1 or 2 channels, 44100 - 96000 Hz, 8 or 16 bits per sample.

Another possibility is to read the electric signal directly from the sound card. This source of electric signal is supported, but not recommended as it requires error-prone processing of the signal in real time.

Turbo systems supported by the decoder are the following: Turbo 2000, Turbo 2000 - kilobyte blocks, Super Turbo, Turbo Tape and B-TAPE, KSO Turbo 2000, Turbo Blizzard, Turbo ROM, Atari Super Turbo (AST format only), Hard Turbo, and Lower Silesia Turbo 2000.

The decoder can also work in so called "Monitor mode" that allows you to read raw turbo blocks.

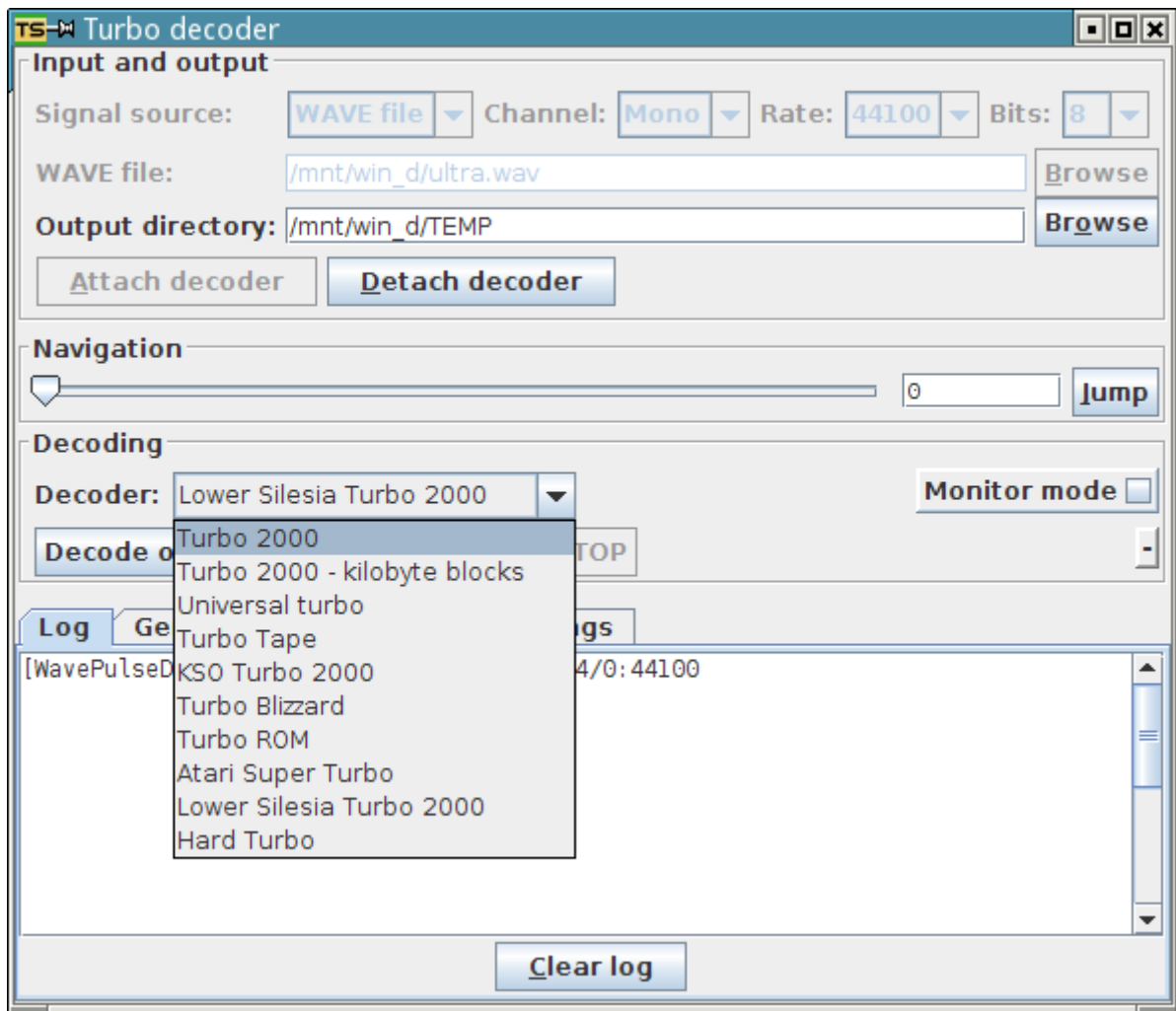


Figure 5: Turbo decoder

6.2.2 Preparing the Decoder

Open the decoder window by selecting the *Turbo decoder* item from the *Tools* menu.

Select source of the electric signal using the *Signal source* combo box.

If the source of the electric signal is a WAVE file, fill-in the WAVE file name and select input channel using the *Channel* combo box.

If the source of the electric signal is the sound card, select input channel using the *Channel* combo box, select the sample rate using the *Rate* combo box, and select number of bits per sample using the *Bits* combo box.

Fill-in the output directory and click the *Attach Decoder* button. The decoder is now ready to decode the electric signal.

6.2.3 Decoding Files

To set various decoding parameters, use controls on the *Settings* tab.

Use the *Navigation* panel to specify current position in the WAVE file.

The controls on the *Decoding* panel are devoted to perform decoding. Use the combo box *Decoder* to select a turbo system.

To start decoding of one file or all files until the end of the WAVE file, click *Decode one file* or *Decode until EOF* buttons. To stop the decoding process, press the *Stop* button.

You can see the results of decoding in the *Log* tab. If you use a digitized sound editor, you can use the sample numbers enclosed in the curly braces.

If you want to work with different WAVE file, or to select another source of the electric signal, detach the turbo decoder using the *Detach decoder* button.

If the decoder stops responding due to a bad sound card setup, press the *Stop* button while pressing the SHIFT key. This is called emergency stop. After an emergency stop, the decoder must be detached and attached to be ready again.

6.2.4 Monitor Mode

To work in the monitor mode, select the *Monitor mode* check box. In the Turbo monitor mode, turbo decoder reads raw blocks of the selected turbo system. If a block is found, it is decoded until an error occurs or end of block is encountered. No checksums are verified and internal format of the block is not validated.

To decode a single block, click the *Decode one file* button. To decode all blocks until end of file, click the *Decode until EOF* button.

The monitor mode is available for special purposes like decoding data stored in non-standard formats, retrieving corrupted files etc.

6.3 Embedding Tokenized BASIC Files to Binary Files

6.3.1 Motivation

Some turbo systems define file formats than cannot accommodate tokenized BASIC files. In order to circumvent such limitation, TS has a tool that embeds tokenized BASIC files in monolithic binary files. **The purpose of the tool is embedding, not compilation.**

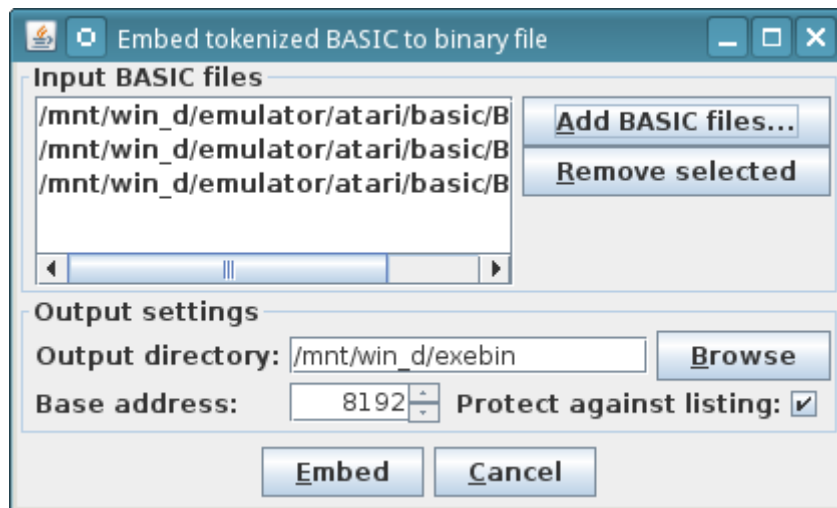


Figure 6: Embedding tokenized BASIC files to binary files

6.3.2 Operations

Open the embedding tool window by selecting the *Embed BASIC to binary file* item from the *Tools* menu.

Click the *Add BASIC files...* button to display a file chooser that allows you to select BASIC files to be embedded to binary files. Chosen files are added to a list. You can select multiple files to be embedded. Click the *Remove selected* button to remove BASIC files from the list.

Use the *Output directory* text field to specify into which directory the binary files will be placed. Use the *Browse* button to specify the directory using a file chooser.

Use the *Base address* spinner to specify address to which the BASIC files will be loaded (tokenized BASIC code is relocatable).

Use the *Protect against listing* check box to protect the BASIC program against listing by disabling the BREAK key and setting the COLDST flag. Note that such protection is only rudimentary and can be broken easily.

To embed the selected BASIC files in binary files, click the *Embed* button. All BASIC files in the list will be embedded in binary files. A report is displayed after embedding processing finishes.

6.4 Tape Image Extractor

Tape image extractor is a tool designed to extract data from tape images. Tape image extractor allows you to do the following:

1. Display basic information about tape image chunks
2. Select tape image chunks for data extraction
3. Determine which portions of tape image chunks will be extracted
4. Extract data from tape image chunks to plain data files
5. Extract boot files to binary files
6. Extract data from tape image chunks to binary files

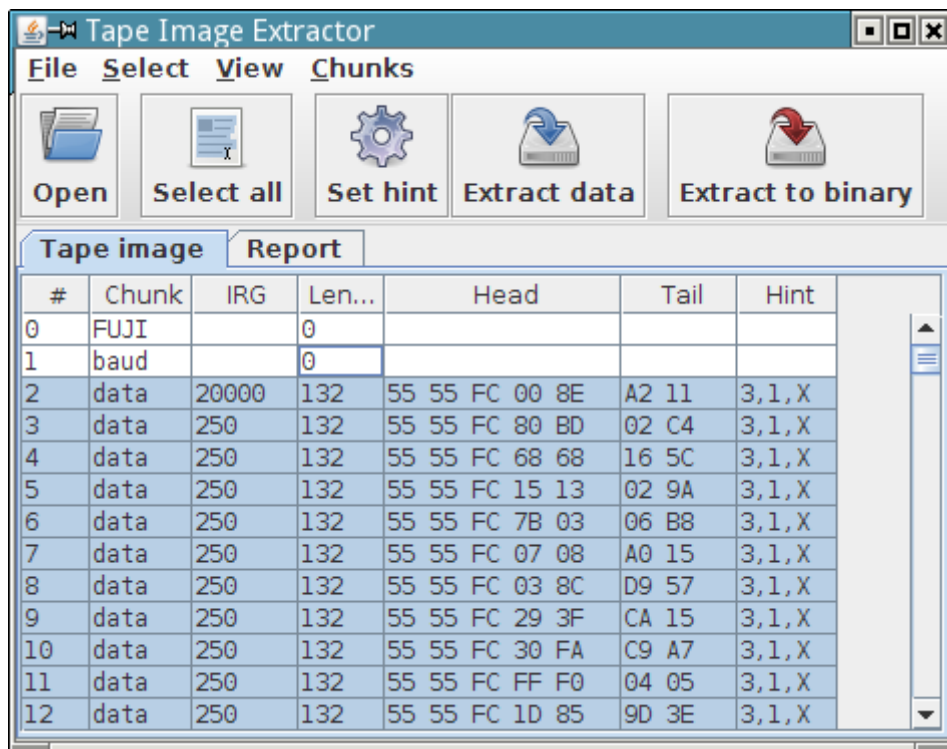


Figure 7: Tape Image Extractor

6.4.1 Operations

To open the Tape Image Extractor window, select the *Tape image extractor* item from the *Tools* menu.

To open a tape image, select the *Open tape image* item from the *File* menu.

To extract data from tape image chunks, select one or more tape image chunks. Then select the *Extract data* item from the *Chunks* menu. Select output file using the displayed file chooser. A report is displayed after the extraction.

To extract data from tape image chunks to a binary file, select one or more tape image chunks. Then select the *Extract data to binary file* item from the *Chunks* menu. A dialog that will allow you to select output file and parameters of the extraction will be displayed. Enter values and click the *Extract* button to perform the extraction.

To determine which portion of tape image chunk or chunks will be extracted, select one or more tape image chunks. Then select the *Set data extraction hint* from the *Chunk* menu. Enter values and click the *OK* button.

7 Hardware that Can Be Used with TURGEN SYSTEM

7.1 Data Recorders and Compact Cassettes

For best experience with TURGEN SYSTEM, use a data recorder with a turbo upgrade and quality compact cassettes.

You have to use standard compact cassettes with data recorders. Such compact cassettes have one of the following markings: **IEC I, TYPE I, NORMAL BIAS, or NORMAL POSITION.**

Do not use compact cassettes marked as CHROME, METAL, or HIGH POSITION. The data recorders were not designed to be used with them.

7.2 Cassette Adapters

If you do not wish or cannot use compact cassettes, you can try affordable and available cassette adapter. This device looks like a compact cassette, but there is no tape inside. Instead of using the tape, the cassette adapter is connected to an external source of signal using a thin cable with JACK connector.

The cassette adapter is very versatile, as it can be connected to various devices like CD players, MP3 players or similar devices. Also do not forget that the cassette adapter will work with data recorders that can no more spin the reels, but their electrical circuitry is still intact.

The Cassette adapter is most useful when connected to a computer where TURGEN SYSTEM is running.

To use the cassette adapter, place it into your data recorder (ensure that its top side is oriented correctly) and connect it to an external signal source. Also make yourself familiar with the concept of silence lists (see section 3.8) for reasons stated in section 7.5.

7.3 MEGA-CD Interface (CD-LINK)

This interface allows you to plug an external signal source as it would be a data recorder with Czechoslovak Super Turbo upgrade. In essence, it is an external version of Super Turbo circuitry with a pair of RCA connectors and a SIO connector.

You can use the MEGA-CD interface to transfer Turbo 2000, Super Turbo, Turbo 2000 - kilobyte blocks, and B-TAPE records to Atari. Atari Super Turbo and Turbo ROM should work as well.

The MEGA-CD interface was not originally designed to transfer standard tape records, but with TURGEN SYSTEM, this is also possible when a high-quality signal source is used (computer, CD player, or MP3 player). To transfer standard tape records, you must set *Do not modulate standard records* configuration entries to *true*.

7.4 SIO2PC and ATART

With appropriate software, both devices allow transfer of standard tape records. Also Czechoslovak Turbo 2000 records can be transferred using these devices. Refer to section 9.

7.5 Loading Binary Files with Replacement Devices

The greatest common disadvantage of devices other than data recorders and compact cassettes (let us call them all **replacement devices**) is that they cannot be controlled by the Atari computer.

When a binary loader loads a binary file, it stops the data recorder after each block or segment loaded. Then the data is processed, the data recorder is activated and loading continues.

The replacement devices cannot be stopped by the Atari computer. This is usually harmless when DATA segments of binary files are loaded, because processing of DATA segments is fast. On the other hand, processing of INIT segments can take considerable amounts of time as virtually any code can be executed. Even a code that waits for a key press. Without appropriate countermeasures, blocks of data can be accidentally skipped.

To remedy the problem stated, TURGEN SYSTEM supports silence lists. The silence lists allow to generate silence or pause the signal generator after blocks that contain INIT segments.

If you are using a replacement device, it is strongly recommended that you make yourself familiar with the silence lists and use them.

For more information about the silence lists, refer to section 3.8.

8 Postprocessing

TURGEN SYSTEM allows to process its outputs by external programs. This is called *postprocessing*. After the output is created, an external program according to the given *command line* is executed.

To reference the TURGEN SYSTEM's output in the command line, some special symbols are introduced. Meaning of the symbols is described in table 3.

If the command line starts with the exclamation mark (!), output file is deleted after the external program terminates, if possible.

Processing of the command line is very limited. The command line is interpreted as a sequence of strings separated by spaces. The first string is name (possibly including path) of the external program, the remaining strings are parameters passed to it. Parameters containing spaces have to be enclosed in double quotes.

Command lines (after special symbol substitution) are always stored into the `turgen.log` file, so the correctness of command lines can be verified.

Symbol	Meaning
%OD%	Output directory
%ODS%	Output directory followed by file separator
%OFN%	Output file name without last extension
%OFNE%	Output file name with last extension

Table 3: Special symbols

8.1 Postprocessing of WAVE Files

To switch on postprocessing of the WAVE files, select the *Wave postprocessing* check box menu item from the *Generator* menu. Specify the command line in the Wave generator/Postprocessing command configuration entry.

8.2 Postprocessing of Tape Images

To switch on postprocessing of the tape images, select the *Tape image postprocessing* check box menu item from the *Generator* menu. Specify the command line in the Tape image generator/Postprocessing command configuration entry.

8.3 Examples

Example of special symbols for output file: `/mnt/win_d/emulator/atari/wav/river_raid.wav`

`%OD% = /mnt/win_d/emulator/atari/wav`

`%ODS% = /mnt/win_d/emulator/atari/wav/`

`%OFNE% = river_raid.wav`

`%OFN% = river_raid`

Example of conversion to MP3:

`lame %ODS%%OFNE% %ODS%%OFN%.mp3`

Example of conversion to OGG Vorbis with deletion of the original file:

`!oggenc -o %ODS%%OFN%.ogg %ODS%%OFNE%`

Conversion to MP3 using LAME in the terminal emulator and consequent playback by xmms media player. The original file is deleted:

`!konsole -e bash -c "lame %ODS%%OFNE% %ODS%%OFN%.mp3 && xmms %ODS%%OFN%.mp3"`

9 Data Transfer via Serial Port in Collaboration with CAS COM Utility

9.1 Introduction

CAS COM is a small utility for loading tape images to Atari via serial port. It supports standard and Turbo 2000 cassette images (namely tr2k tape image chunks). CAS COM works with SIO2PC, ATART or compatible hardware interfaces.

CAS COM can be used as postprocessor of tape images created by TURGEN SYSTEM. Since CAS COM is currently available only for Microsoft Windows operating systems, the following text presumes that such operating system is used.

CAS COM has a web page: http://sdq.czweb.org/old_computers/atari/projects/cascom/index.html.

To use CAS COM, set the *Tape image generator/Tape image chunks* configuration entry to *trXX*.

9.2 Command Line Considerations

Let us presume that CAS COM resides in C:\UTILS\ATARI directory. The configuration entry Tape image generator/Postprocessing command should have the following value:

```
cmd /x C:\UTILS\CASCOM\CASCOM.EXE %ODS%%OFNE%
```

It is important to add command line interpreter to the command line, because CAS COM uses console I/O to display important information. Users of Microsoft Windows 95/98/98SE/ME should use `command` instead of `cmd`.

CAS COM accepts other useful command line parameters. `/S` starts tape image loading immediately, `/e` terminates program after data transfer. Moreover `/1`, `/2`, `/3`, `/4` or `/c<num>` parameters allow to choose serial port.

10 Hints and Tips

- If the SHIFT key is pressed when the *Add item to playlist* main control button is pressed, the contents of the playlist item manipulation dialog will not be cleared. This can be used to duplicate playlist items.
- A good way how to reduce loading times is to reduce length of pilot tones.
- Don't forget that you can resize program windows as you want. Bounds of the windows are persistent, so if you exit the TS and restart it, you will find the windows exactly where you left them.
- If you, for some reason, store the generated electric signal on compact discs (CDs) and you use compact disc player, try to switch off various shock protections and avoid nonstandard rotational speeds. Such features sometimes cause sample losses.

Part II

BUILT-IN PLUGINS

11 Turbo 2000 and Super Turbo

11.1 Characteristics

Plugins convert input files to Czechoslovak turbo systems **Turbo 2000** and **Super Turbo**. Both plugins also provide means to circumvent main limitation of both systems - the incapability to accommodate segmented binary files. User interface is depicted on figure 8.

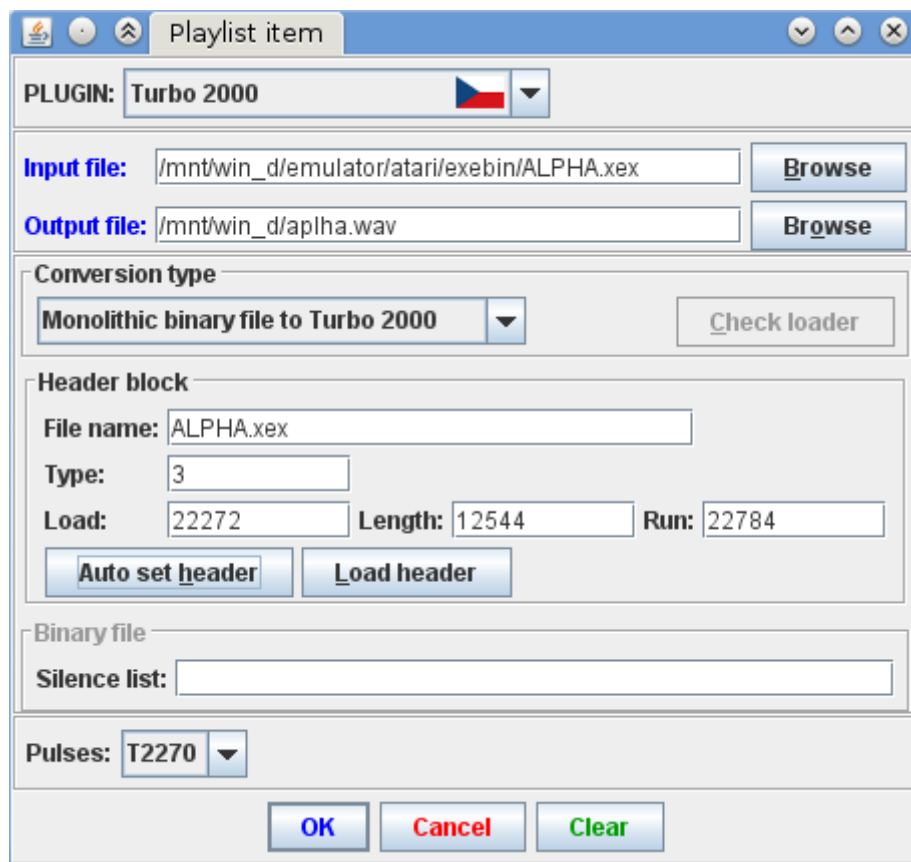


Figure 8: Turbo 2000, Super Turbo

11.2 Conversion types

Turbo 2000 and Super Turbo support up to 6 conversion types. Choose conversion type using the *Conversion type* combo box.

Monolithic binary file to Turbo 2000 or Super Turbo. Conversion of a monolithic binary file (see 1.9). The input file must be a monolithic binary file. This is a natural usage of Turbo 2000 or Super Turbo systems.

ChainLoading. Conversion of segmented binary file to *chain of Turbo 2000 or Super Turbo block pairs*. A special binary loader (Chainloader) that loads the block pairs is prepended before the chain. Use the *Check loader* button to determine whether the special binary loader will be destroyed by the binary file.

BlockLoading. Conversion of segmented binary file to *chain of Turbo 2000 or Super Turbo blocks*. A special binary loader (Blockloader) that loads the blocks (and accommodates information where to place the blocks in the memory) is prepended before the chain. The binary file can have up to 62 segments. Use the *Check loader* button to determine whether the special binary loader will be destroyed by the binary file.

Tokenized BASIC to Turbo 2000 or Super Turbo. Conversion of tokenized BASIC program. Note that many loaders cannot load such program directly. To circumvent such limitation, you can embed tokenized BASIC to binary file. See section 6.3.

Plain DATA to Turbo 2000 or Super Turbo. Conversion of plain data.

Binary file to binary turbo. Conversion of binary file to Binary turbo (file type 4) format. This conversion type is available only for the Turbo 2000 plugin. VisiCopy III loader is able to load and execute such file, but it must not contain any INIT segments.

11.3 Header Block

Use the text fields *File name*, *Type*, *Load*, *Length* and *Run* to specify entries of the Turbo 2000 or Super Turbo header block.

Click the *Auto set header* button to automatically enter values in the text fields mentioned above. The information is obtained by analysis of the input file and the selected conversion type. Furthermore, if the input file is not a monolithic binary file and according to the selected conversion type it should be, a warning dialog with recommendations is displayed.

Click the *Load header* to load the turbo header from an external file. The header is loaded automatically if it is stored in a file that is named same as the input file followed by a *.thead*er suffix. In other cases, a file chooser is displayed.

11.4 Inserting Silence After INIT Segments

The text field *Silence list* contains a silence list (refer to section 3.8). This is applicable only for ChainLoading and BlockLoading conversion types.

11.5 Prepending Universal Turbo Loader

If you do not have a cartridge with Turbo 2000 or Universal Turbo loader, you can prepend a cassette version of such loader. Set the *Prepend Universal Turbo loader* configuration entry to *true*.

11.6 Configuration Entries

Turbo 2000/Header block pilot tone length

Number of pilot tone pulses of the header block (256-8192)

Turbo 2000/Data block pilot tone length

Number of pilot tone pulses of the data block (256-8192)

Turbo 2000/Silence after header

Duration of silence that is generated after the header block (0-30). Note that many Universal Turbo loaders do not tolerate silence after header.

Turbo 2000/Pause after header

If set to true, output of electric signal to sound card will be paused after the header block. This can be useful for Turbo 2000 only loaders that wait for a key press. Note that many Universal Turbo loaders do not tolerate any interruptions after the header block.

Turbo 2000/Pilot tone length for BlockLoading

Number of pilot tone pulses of data blocks for BlockLoading conversion type (256-8192)

Turbo 2000/Prepend Universal Turbo loader

Prepend Universal Turbo loader as a standard cassette boot file

Super Turbo/Header block pilot tone length

Number of pilot tone pulses of the header block (256-8192)

Super Turbo/Data block pilot tone length

Number of pilot tone pulses of the data block (256-8192)

Super Turbo/Pilot tone length for BlockLoading

Number of pilot tone pulses of data blocks for BlockLoading conversion type (256-8192)

Super Turbo/Prolongate pilot tone

Increase number of pilot tone pulses with increasing approximate baud rate

Super Turbo/Silence after header

Duration of silence that is generated after the header block (0-30). Note that many Universal Turbo loaders do not tolerate silence after header.

Super Turbo/Prolongate pilot tone for BlockLoading

Increase number of pilot tone pulses with increasing approximate baud rate for BlockLoading conversion type

Super Turbo/Convert binary loaders to Turbo 2000

If set to true, the Chainloader and Blockloader binary loaders are converted to Turbo 2000 instead of Super Turbo.

Super Turbo/Prepend Universal Turbo loader

Prepend Universal Turbo loader as a standard cassette boot file

12 Turbo 2000 - Kilobyte Blocks

12.1 Characteristics

Plugin converts files to **Turbo 2000 - kilobyte blocks** Czechoslovak turbo system. There are no special restrictions on input files.

12.2 User Interface

The user interface is depicted on figure 9.

The text field *File name* corresponds to the same field of the Turbo 2000 - kilobyte blocks header block. The purpose of the text field *Silence list* is described in section 3.8.

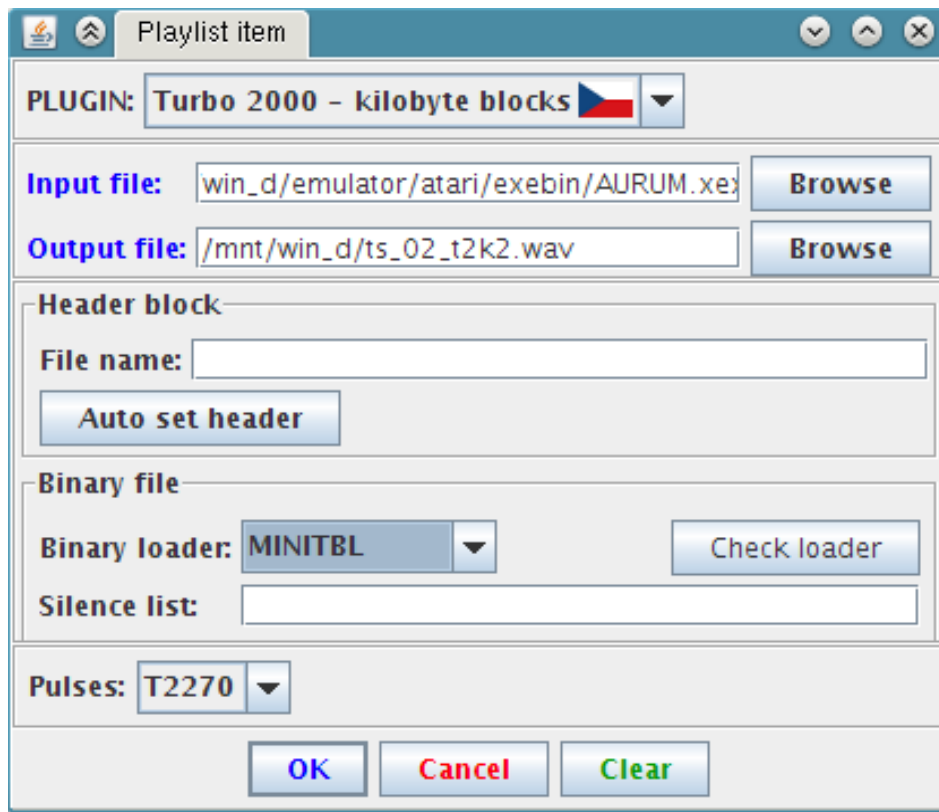


Figure 9: Turbo 2000 - kilobyte blocks

12.3 Binary Loaders

Turbo 2000 - kilobyte blocks turbo system can accommodate binary files. You can prepend one of the special miniature built-in binary loaders. For this turbo system, you can choose MINITBL, NANOTBL, NANOTBL[UR] or NANOTBL[U2] loader by using the *Binary loader* combo box. The loader is converted to the Turbo 2000 system.

MINITBL loader is a combination of stripped "T:" device handler that allows only READ operation and code for binary load using CIO. NANOTBL loaders are single-purpose binary loaders reading data blocks, not using CIO at all. NANOTBL stores data blocks to the freely available RAM. NANOTBL[UR] stores the data blocks to the beginning of the "RAM under ROM", NANOTBL[U2] to the end of "RAM under ROM".

Use the *Check loader* button to verify whether the binary file will destroy the selected binary loader.

12.4 Prepending Universal Turbo Loader

If you don't have a cartridge with Turbo 2000 or Universal Turbo loader, you can prepend a cassette version of such loader. Set the *Prepend Universal Turbo loader* configuration entry to *true*.

12.5 Configuration Entries

Turbo 2000 - kilobyte blocks/Header block pilot tone length

Number of pilot tone pulses of the header block (256-8192)

Turbo 2000 - kilobyte blocks/Data block pilot tone length

Number of pilot tone pulses of the data blocks (256-8192)

Turbo 2000 - kilobyte blocks/Silence after header

Number of seconds of the silence inserted after the header block (0-30)

Turbo 2000 - kilobyte blocks/Silence after loader

Number of seconds of the silence inserted after the binary loader (0-30)

Turbo 2000 - kilobyte blocks/Name loader same as file

The binary loader will have name same as the converted file

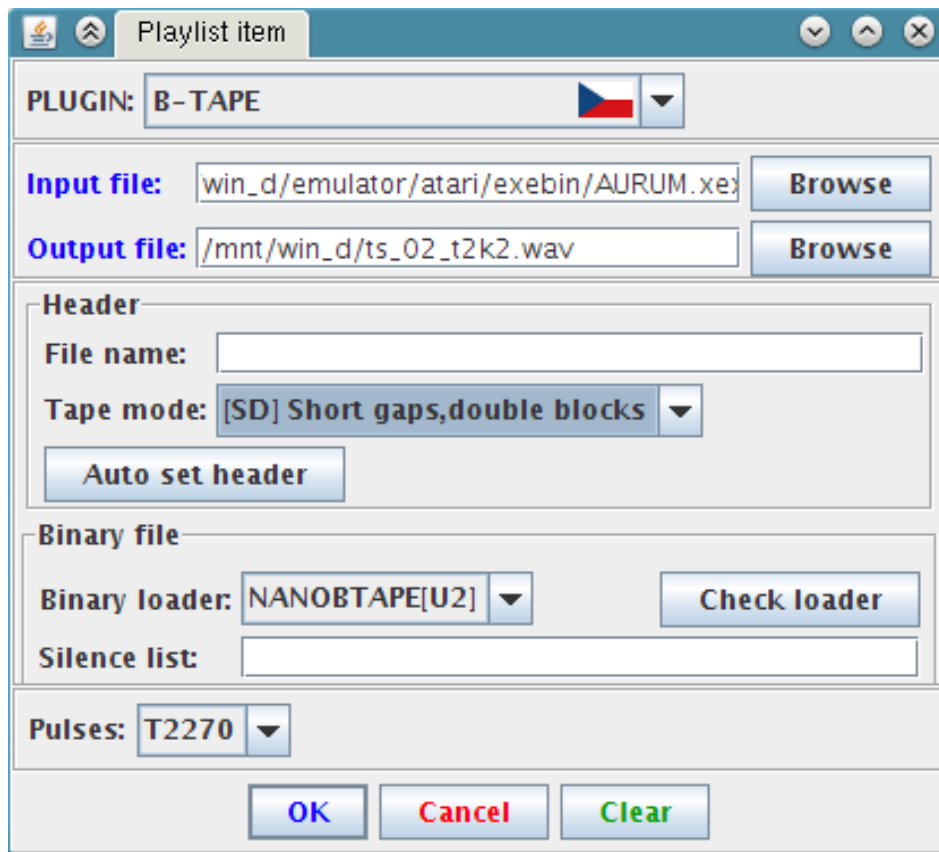


Figure 10: B-TAPE

Turbo - kilobyte blocks/Prepend Universal Turbo loader
Prepend Universal Turbo loader as a standard cassette boot file

13 B-TAPE

13.1 Characteristics

Plugin converts files to **B-TAPE** Czechoslovak turbo system. There are no special restrictions on input files. B-TAPE system is backward compatible with Turbo Tape system used by TT-DOS operating system.

13.2 User Interface

The user interface is depicted on figure 10.

The text field *File name* corresponds to the same field of the B-TAPE data block. The purpose of the text field *Silence list* is described in section 3.8. Use the *Tape mode* combo box to select tape mode.

13.3 Binary Loaders

B-TAPE turbo system can accommodate binary files. You can prepend one of the special miniature built-in binary loaders. For this turbo system, you can choose NANOBTAPE, NANOBTAPE[UR] or NANOBTAPE[U2] loader using the *Binary loader* combo box. The loader is converted to the Turbo 2000 system.

NANOBTAPE loaders are single-purpose binary loaders reading blocks, not using CIO at all. NANOBTAPE stores the blocks to freely available RAM. NANOBTAPE[UR] stores the blocks to the beginning of the “RAM under ROM”, NANOBTAPE[U2] to the end of “RAM under ROM”.

Use the *Check loader* button to verify whether the binary file will destroy the selected binary loader.

13.4 Prepending Universal Turbo Loader

If you don't have a cartridge with Turbo 2000 or Universal Turbo loader, you can prepend a cassette version of such loader. Set the *Prepend Universal Turbo loader* configuration entry to *true*.

13.5 Configuration Entries

B-TAPE/Pilot tone length

Number of pilot tone pulses of the blocks (256-8192)

B-TAPE/Prolongate pilot tone

Increase number of pilot tone pulses with increasing approximate baud rate

B-TAPE/Silence after first block

Number of seconds of the silence inserted after the first B-TAPE block (0-30)

B-TAPE/Silence after loader

Number of seconds of the silence inserted after the binary loader (0-30)

B-TAPE/Name loader same as file

The binary loader will have name same as the converted file

B-TAPE/Force tr2k tape image chunks

The generated trXX type tape image chunks will be tr2k instead of trbt. This allows the CAS COM utility to transfer files in the B-TAPE format.

B-TAPE/Prepend Universal Turbo loader

Prepend Universal Turbo loader as a standard cassette boot file

14 KSO Turbo 2000

14.1 Characteristics

Plugin converts files to **KSO Turbo 2000** Polish turbo system. There are no special restrictions on input files. KSO Turbo 2000 system is compatible with various similar turbo systems (e.g. Turbo 2000F).

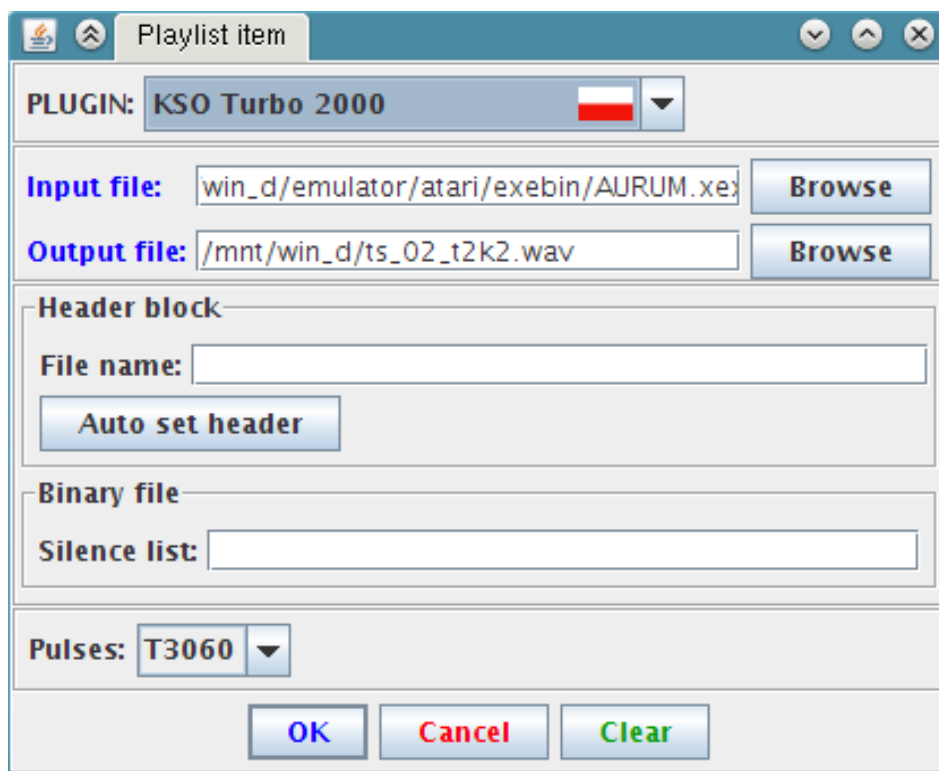


Figure 11: KSO Turbo 2000

14.2 User Interface

The user interface is depicted on figure 11.

The text field *File name* corresponds to the same field of the header block. The purpose of the text field *Silence list* is described in section 3.8.

14.3 Configuration Entries

KSO Turbo 2000/Invert polarity of pulses

Invert polarity of pulses

KSO Turbo 2000/Header block pilot tone length

Number of pilot tone pulses of the header block (256-8192)

KSO Turbo 2000/Data block pilot tone length

Number of pilot tone pulses of the data blocks (256-8192)

KSO Turbo 2000/Silence after header

Number of seconds of the silence inserted after the header block (0-30)

KSO Turbo 2000/Pause after header

If set to true, output of electric signal to sound card will be paused after the header block

KSO Turbo 2000/Pulse Corrections

Corrections of pulses

15 Turbo Blizzard

15.1 Characteristics

Plugin converts files to **Turbo Blizzard** Polish turbo system. There are no special restrictions on input files.

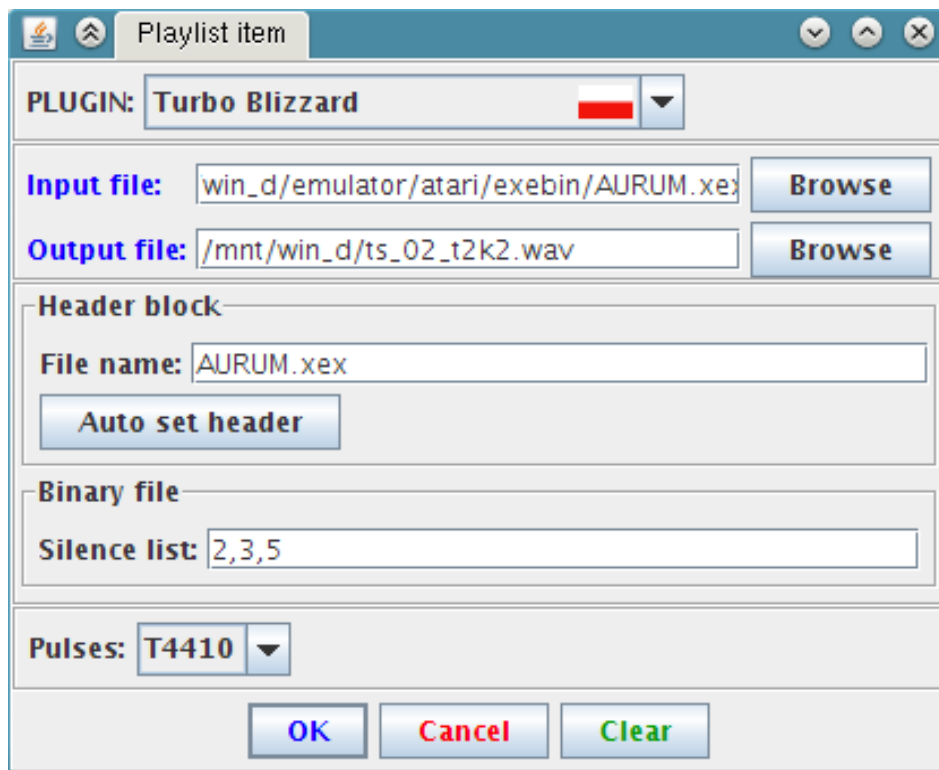


Figure 12: Turbo Blizzard

15.2 User Interface

The user interface is depicted on figure 12.

The text field *File name* corresponds to the same field of the header block. The purpose of the text field *Silence list* is described in section 3.8.

15.3 Configuration Entries

Turbo Blizzard/Invert polarity of pulses

Invert polarity of pulses

Turbo Blizzard/Long gaps between blocks

Make long gaps between blocks

Turbo Blizzard/Silence after header

Number of seconds of the silence inserted after the header block (0-30)

Turbo Blizzard/Pause after header

If set to true, output of electric signal to sound card will be paused after the header block

Turbo Blizzard/Pulse Corrections

Corrections of pulses

16 Turbo ROM

16.1 Characteristics

Plugin converts files to **Turbo ROM** Polish turbo system. The following input files are supported:

- Turbo ROM compatible binary files
- Binary files
- Tokenized BASIC files

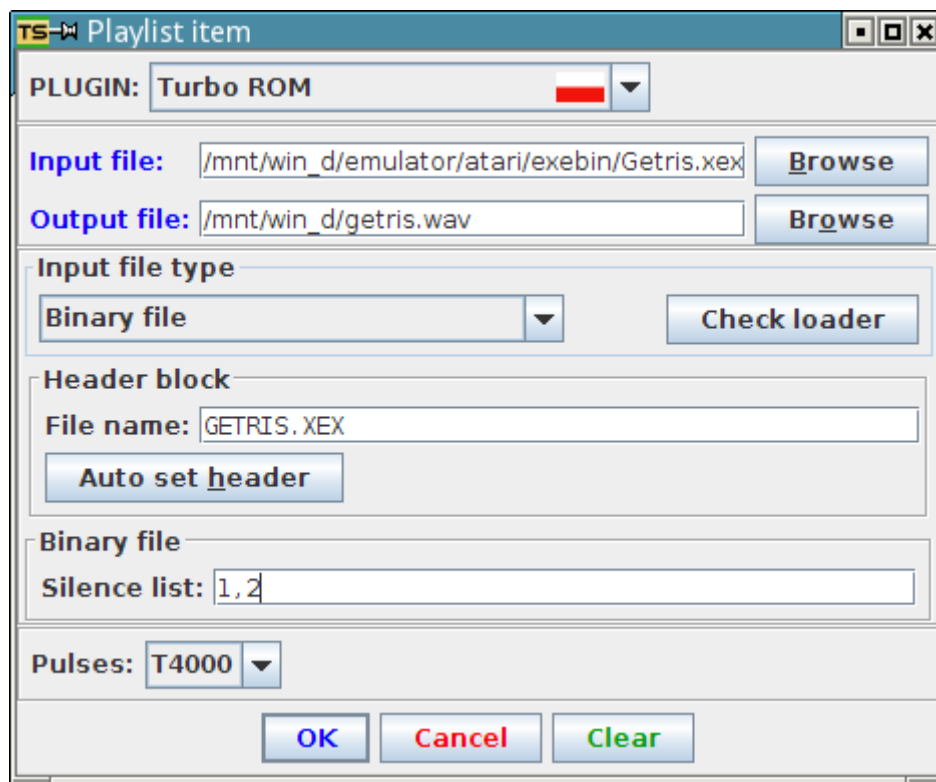


Figure 13: Turbo ROM

16.2 User Interface

The user interface is depicted on figure 13.

The text field *File name* corresponds to the same field of the header block. Use the *Auto set header* button to automatically set file name and also to verify whether the input file is Turbo ROM compatible binary file.

Use the *Input file type* combo box to select input file type.

16.3 Conversion of Turbo ROM Compatible Binary Files

These binary files consist of exactly one DATA segment and at most one RUN segment and at most one INIT segment. Files are converted to the Turbo ROM natural format.

16.4 Conversion of Binary Files

16.4.1 Processing

Binary Files are converted to a special format. A special binary loader in Turbo ROM natural format is prepended. Binary files are normalized before conversion (RUNINIT segments are split, RUN segment is moved to the end of the file).

16.4.2 User Interface

Use the *Check loader* button to verify whether the binary file will destroy the binary loader. The purpose of the text field *Silence list* is described in section 3.8.

16.5 Conversion of Tokenized BASIC Files

Files are converted to Turbo ROM natural format for tokenized BASIC files.

16.6 Prepending Loaders

If you do not have a cartridge with Turbo ROM loader, you can prepend a cassette version of such loader. Set the *Prepend Turbo ROM loader*, and *Convert binary loader to a standard cassette boot file* configuration entries to *true*.

16.7 Configuration Entries

Turbo ROM/Invert polarity of pulses

Invert polarity of pulses

Turbo ROM/Header pilot tone length

Number of pilot tone pulses of the header block (1024-8192)

Turbo ROM/Data block pilot tone length

Number of pilot tone pulses of the data block (128-2048)

Turbo ROM/Binary load pilot tone length

Number of pilot tone pulses of blocks when binary files are converted

Turbo ROM/Silence after header

Number of seconds of the silence inserted after the header block

Turbo ROM/Pause after header

If set to true, output of electric signal to sound card will be paused after the header block

Turbo ROM/Silence after binary loader

Number of seconds of the silence inserted after binary loader

Turbo ROM/Convert binary loader to a standard cassette boot file

If set to true, the binary loader is converted to a standard cassette boot file instead of a Turbo ROM compatible binary file.

Turbo ROM/Prepend Turbo ROM loader

Determines if a Turbo ROM natural format loader will be prepended as a standard cassette boot file. The

values are the following: “None” - no loader will be prepended, “Standard” - a plain loader will be prepended, “Diagnostic” - a verbose loader that displays hexadecimal dump of the header block will be prepended.

Turbo ROM/LOAD address of a BASIC program

Base address to which BASIC programs will be loaded

Turbo ROM/RUN address of a BASIC program

Address of a routine that executes BASIC programs (default is 41086)

Turbo ROM/Generate loader only

When set to true, only a loader is converted by the plugin.

Turbo ROM/Pulse Corrections

Corrections of pulses

17 Atari Super Turbo

17.1 Characteristics

Plugin converts files to **Atari Super Turbo** Polish turbo system. Conversion of binary files to the following formats is supported:

- AST format that can accommodate binary files that have up to 44 segments and no INIT segments.
- BUT format that can accommodate binary files that have up to 254 segments of any type. A generic BUT loader is used to load such files. The loader occupies addresses 1926 - 2185.

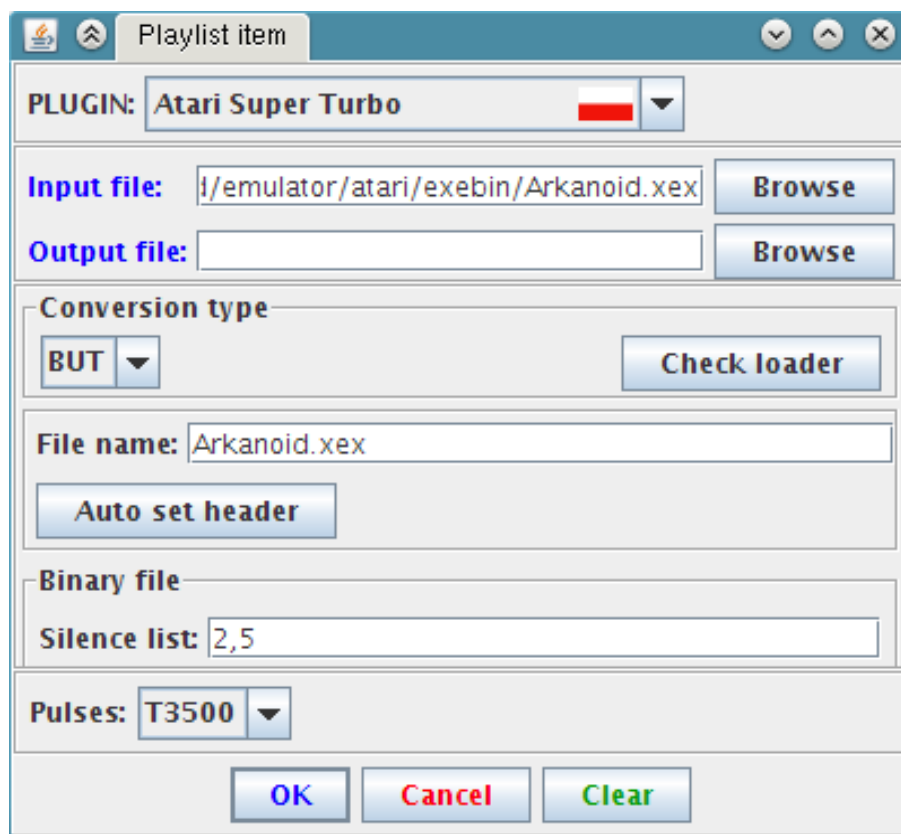


Figure 14: Atari Super Turbo

17.2 User Interface

The user interface is depicted on figure 14.

The text field *File name* corresponds to the same field of the header block. The *Auto set header* button can be used to automatically set file name and also to verify whether the input file is compatible with the selected format (AST or BUT). The purpose of the text field *Silence list* is described in section 3.8.

17.3 Configuration Entries

Atari Super Turbo/Invert polarity of pulses

Invert polarity of pulses

Atari Super Turbo/AST header pilot tone length

Number of pilot tone pulses of the AST header block (256-16384)

Atari Super Turbo/Data block pilot tone length

Number of pilot tone pulses of data blocks (256-16384)

Atari Super Turbo/Silence after AST header

Number of seconds of the silence inserted after the header block (0-30)

Atari Super Turbo/Pause after header

If set to true, output of electric signal to sound card will be paused after the header block

Atari Super Turbo/BUT loader will wait for any key

Determines whether the BUT loader will require a key press to proceed

Atari Super Turbo/Silence after BUT loader

Duration of silence generated after BUT loader

Atari Super Turbo/Pulse Corrections

Corrections of pulses

18 Hard Turbo

18.1 Characteristics

Plugin converts files to the **Hard Turbo** Polish turbo system. According to the nature of this turbo system, input files must be binary files.

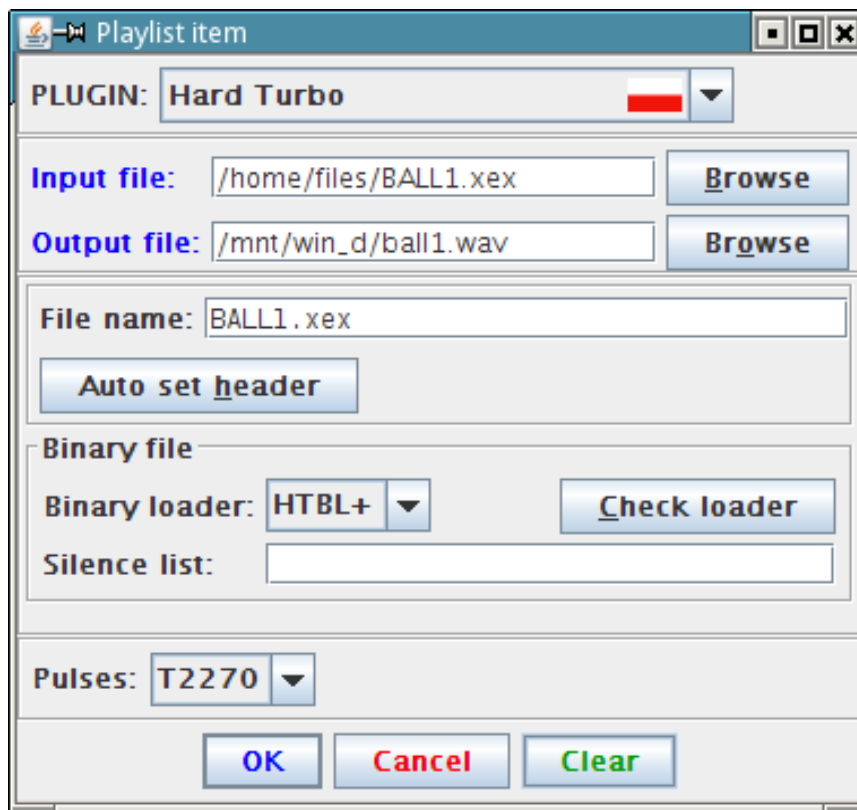


Figure 15: Hard Turbo

18.2 User Interface

The user interface is depicted on figure 15.

The text field *File name* corresponds to the same field of the main header block. Use the *Auto set header* to automatically set file name. The purpose of the text field *Silence list* is described in section 3.8.

18.3 HTBL+ Loader

You can add HTBL+ loader before the binary file converted.

HTBL+ is an extended binary loader that has the following enhancements

- Data recorder motor is switched off after segment data is loaded. This enables loading of binary files that execute lot of code from INIT segments
- RUNAD is set in a way that allows RUN segment to be the first segment of the binary file
- The loader never waits for any key under normal circumstances. This makes the loader easier to use with devices that do not support MOTOR CTRL signal
- The loader forces warm start during its initialization. This allows to load and run programs that rely on the display configuration set up by the warm start routines
- BASIC is automatically disabled

To add the HTBL+ loader, select HTBL+ from the *Binary loader* check box. Use the *Check loader* button to verify whether the binary file will destroy the HTBL+ loader.

18.4 Configuration Entries

Hard Turbo/Invert polarity of pulses

Invert polarity of pulses

Hard Turbo/Header block pilot tone length

Number of pilot tone pulses of the header block (256-16384)

Hard Turbo/Data block pilot tone length

Number of pilot tone pulses of data blocks (256-16384)

Hard Turbo/Silence after AST header

Number of seconds of the silence inserted after the header block (0-30)

Hard Turbo/Pause after header

If set to true, output of electric signal to sound card will be paused after the header block

Hard Turbo/Name loader same as file

The binary loader will have name same as the converted file

19 Lower Silesia Turbo 2000

19.1 Characteristics

Plugin converts binary files to the **Lower Silesia Turbo 2000** turbo system from Poland.

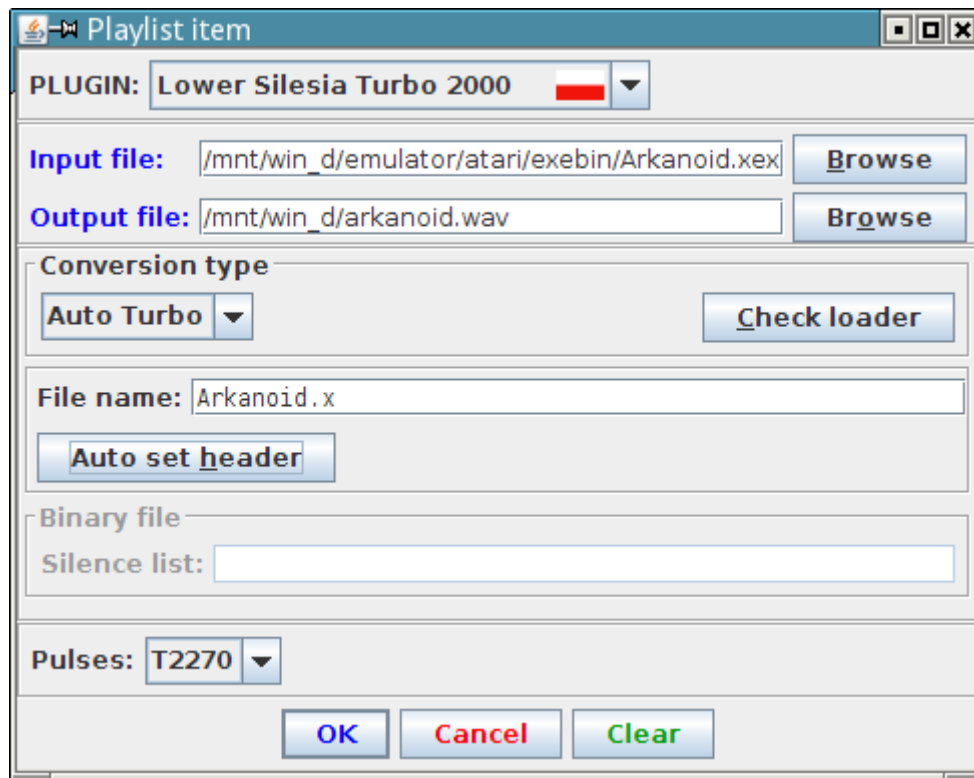


Figure 16: Lower Silesia Turbo 2000

19.2 Conversion Types

Two conversion types are supported.

Auto Turbo. Conversion of input binary file to the Auto Turbo format (see section 25.6.2). The Auto Turbo format can accommodate any binary file, but only binary files that have no INIT segments can be loaded and executed.

UE Protected Binary. Conversion of input binary file to the Protected Binary Format (see section 25.6.3) use by the “Unknown Exterminator” copier. A binary loader is converted to the Auto Turbo format. Then the input binary file is converted to the Protected Binary Format.

19.3 User Interface

The user interface is depicted on figure 16.

The text field *File name* corresponds to the same field of the header block. Click the *Auto set header* button to automatically set the file name. Select conversion type using the *Conversion type* box. The purpose of the text field *Silence list* is described in section 3.8.

Click the *Check loader* button to check whether the selected input file is compatible with Auto Turbo or binary loader.

19.4 Configuration Entries

Lower Silesia Turbo 2000/Header block pilot tone length

Number of pilot tone pulses of the header block (256-8192)

Lower Silesia Turbo 2000/Data block pilot tone length

Number of pilot tone pulses of the data block (256-8192)

Lower Silesia Turbo 2000/Silence after AST header

Number of seconds of the silence inserted after the header block (0-30)

Lower Silesia Turbo 2000/Pause after header

If set to true, output of electric signal to sound card will be paused after the header block

Lower Silesia Turbo 2000/Segment header pilot tone length

Number of pilot tone pulses of the segment header block (128-768)

Lower Silesia Turbo 2000/Silence after loader

Duration of silence generated after binary loader

20 Standard

20.1 Characteristics

Plugin converts input files to standard tape records. Transfer speed is always 600 bd. The following input files are supported:

- Monolithic binary files
- Segmented binary files
- Tokenized BASIC files and BASIC source code files
- Plain data files

20.2 User Interface

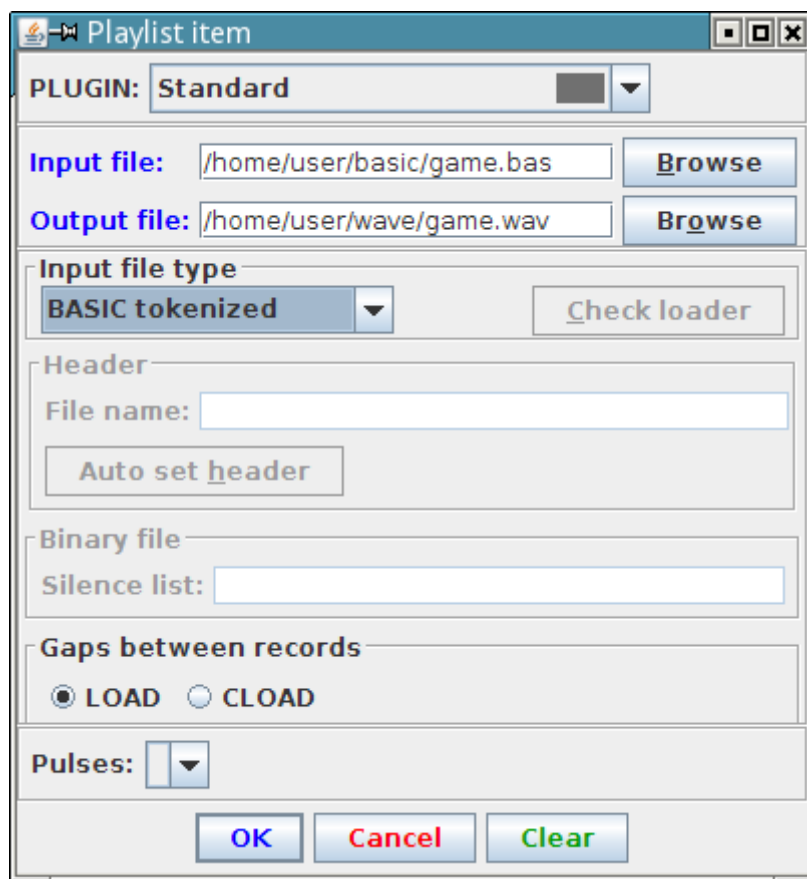


Figure 17: Standard

User interface is depicted on figure 17.

Use the *Input file type* combo box to select input file type. Use the *Gaps between records* box to set duration of gaps between records. Use the *Check loader* button to verify whether the binary file will destroy a binary loader.

20.3 Conversion of Monolithic Binary Files

Monolithic binary files are converted to boot files. The following limitations apply for monolithic binary files:

- The DATA segment cannot occupy memory below address 1536
- Length of the DATA segment must not exceed 32649 bytes

20.4 Conversion of Segmented Binary Files

20.4.1 Processing

Segmented binary files are converted as follows:

- A binary loader skeleton is customized and converted to a boot file. Binary loader switches motor off after every INIT segment.
- The binary file is normalized (RUNINIT segments are split, RUN segment is moved to the end of the file)
- Segments of the binary file are converted to a sequence of files. A new file with long IRG is created after every INIT segment. This allows proper execution of the INIT segments.
- Duration of inter-record gaps is 375 ms by default. This gives the loader time to process the data loaded.

The following limitations apply for segmented binary files:

- Maximum number of segments is 254
- Binary files must not destroy the binary loader

20.4.2 User Interface

Use the *File name* text field to set name that will be displayed by the binary loader. The purpose of the text field *Silence list* is described in section 3.8. Use the *Check loader* button to verify whether the binary file will destroy the binary loader.

20.5 Configuration entries

Standard/Leader duration

Duration of the leader signal in seconds (10-30).

Standard/Binary loader IRG duration

Duration of the inter-record gaps in milliseconds for standard tape records generated when a segmented binary file is converted. Default value is 375.

Standard/IRG after INIT segment duration

Duration of the inter-record gaps after INIT segments in seconds when a segmented binary file is converted. Default value is 12.

21 Tape Image

Plugin interprets tape images.

21.1 Turbo Records

TURGEN SYSTEM supports **trXX** chunks and **pwmX** chunks.

21.2 Standard Tape Records

Since version 8.3.7, **baud** and dependent **data** chunks are supported. Since version 8.3.8, **fsk** chunks are supported.

Part III

TURBO SYSTEMS

22 Introduction

This part contains information about various turbo systems that have been created in Czechoslovakia and Poland. Descriptions of the systems are sufficient to provide ability to write turbo generators, loaders, copiers and turbo decoders.

23 Information encoding

Information is encoded using pulse width modulation (PWM). In this document, width of pulse is defined as a distance between two transitions from logical zero to logical one. See figure 18.



Figure 18: Pulse and its width

24 Turbo Systems from Former Czechoslovakia

24.1 Common Information

This common information is related only to turbo systems described in this document. These turbo systems are or were widespread in former Czechoslovakia, but of course, there are or were also others.

24.1.1 Switching Data Recorder to Turbo Mode

Switching data recorder to turbo mode is done using electronic switch, that switches to turbo mode if signals COMMAND and MOTOR CTRL are active. Reading of data is done by monitoring signal at pin DATA-IN of the SIO connector. Writing of data is performed by direct change of logical value at DATA-OUT pin of the SIO connector.

24.1.2 Single Purpose or CIO

Two main kinds of Czechoslovak turbo systems can be distinguished:

1. Systems that use single purpose loaders and simple file format that can accommodate only one contiguous block of data (Turbo 2000, Super Turbo). These systems are unable to support binary load operation, although capable to accommodate binary load files themselves.
2. Systems that were created together with tape operating systems: Turbo 2000 - kilobyte blocks, Turbo Tape, B-TAPE. Aim of these systems is to partially or fully replace the disk drive.

24.1.3 Pilot Tone and Data Separation

All Czechoslovak turbo systems use same way how to separate pilot tone and data. One sync pulse (which is very narrow pulse) or narrow pulse.

24.2 Turbo 2000

24.2.1 Description

Turbo 2000 was the first turbo system available in former Czechoslovakia. It was developed in 1987 by Jiří Richter, student of Czech Technical University in Prague and member of Prague Atari user club.

Four types of pulses are distinguished: Narrow pulse, wide pulse, pilot tone pulse and sync pulse. Bits are stored in MSB to LSB order.

File stored using Turbo 2000 system consists of two blocks - header block (HEADER) and data block (DATA). Both blocks are preceded by pilot tone (series of at least 256 pilot tone pulses) which is followed by sync pulse (which is very narrow pulse). Recommended number of pilot tone pulses is at least 2000 in order to provide compatibility with "Universal turbo" loaders.

24.2.2 Header block

Offset	Description
0	Always 0
1	File type (1 - plain data, 3 - program, 4 - binary file, 255, 254 - tokenized BASIC)
2-11	File name
12-13	Load address
14-15	Length of file
16-17	Start address
18	Check sum = (HEADER[0]) xor ... xor (HEADER[17])

24.2.3 Data block

Offset	Description
0	Always 255
1-?	Data itself
Last	Check sum = (DATA[0]) xor ... xor (DATA[?])

24.2.4 Timing

Standard transfer speed is approximately 2270 bauds. There is a big tolerance for width of all pulses.

Pulse	Center width	Tolerated range
Pilot tone	32/44100 s	(25-47)/44100 s
Wide	26/44100 s	(20-40)/44100 s
Narrow	13/44100 s	(6-19)/44100 s
Sync	10/44100 s	(4-17)/44100 s

24.2.5 Loaders

In early times, Turbo 2000 loaders were distributed on tapes, stored using standard 600 baud system. Then loaders on cartridges became widespread.

24.3 Super Turbo

24.3.1 Description

Super turbo system is an enhancement of Turbo 2000 system, developed by Jiří Richter. Supported transfer speeds are approximately from 2725 to 6411 bauds.

Two types of pulses are distinguished: Narrow pulse and wide pulse. Bits are stored in MSB to LSB order.

File stored using Super Turbo consists of two blocks - header block (HEADER) and data block (DATA). Both blocks are preceded with pilot tone (series of at least 1200 wide pulses) which is followed by narrow pulse. Recommended number of pilot tone pulses is at least 2000 in order to provide compatibility with available loaders.

24.3.2 Header block

Offset	Description
0	Always 183
1	File type (1 - plain data, 3 - program, 4 - binary file, 255 - tokenized basic)
2-21	File name
22-23	Load address
24-25	Length of file
26-27	Start address
28	Check sum = (HEADER[0]) xor ... xor (HEADER[27])

24.3.3 Data block

Offset	Description
0	Always 237
1-?	Data itself
Last	Check sum = (DATA[0]) xor ... xor (DATA[?])

24.3.4 Timing

Various transfer speeds are supported. For given speed, width of wide pulse is width of narrow pulse simply doubled.

Pulse	Width
Wide	(6/44100 - 22/44100) s
Narrow	(3/44100 - 11/44100) s

24.3.5 Loaders

Special loaders for Super Turbo only are very rare. So called "Universal turbo" loaders capable to load both Turbo 2000 and Super Turbo are widespread, mostly on cartridges. Universal turbo loaders measure speed using examination of three consequent pilot tone pulses. Measured speed is also used to distinguish between Turbo 2000 and Super Turbo.

During the time, so called "Visiloader" has been invented. This loader is able to display progress of loading using PMG.

24.4 Turbo 2000 - kilobyte blocks

24.4.1 Description

Turbo system designed together with various versions of “Turbo operating system” (TOS).

Four types of pulses are distinguished: Narrow pulse, wide pulse, pilot tone pulse and sync pulse. Bits are stored in MSB to LSB order.

File stored using this turbo system consists of many blocks. First block is a header block (HEADER), remaining blocks (BLOCK) are data blocks that have 1026 bytes. Every block is preceded by pilot tone (series of at least 256 pilot tone pulses) which is followed by one sync pulse. Recommended number of pilot tone pulses is at least 2000 in order to provide compatibility with available loaders.

24.4.2 Header block

Offset	Description
0-1	Always 0
2-17	File name
18	Check sum = HEADER[0] xor HEADER[1] xor ... xor HEADER[17]

24.4.3 Data blocks

Offset	Description
0	255=Full block, 250=EOF block. Numbers 251-254 indicate partially filled block. If we subtract 251 from this number, we obtain a difference that will be denoted as Z . This difference can be 0,1,2 or 3 and represents higher byte of number of valid data bytes in the block.
1-1024	Data itself. If the block is a full block, there is 1024 bytes of data. If the block is EOF block, there are all zeros. If the block is a partially filled block, there is data padded with zeros up to the length of 1023 bytes. Last byte is lower byte of number of valid data bytes in the block. If we denote this lower byte as X , the number of valid bytes in the block is $Z * 256 + X$
1025	Check sum = BLOCK[0] xor BLOCK[1] xor ... xor BLOCK[1024]

24.4.4 Timing

Standard transfer speed is approximately 2270 bauds. There is a big tolerance for width of pulses.

Pulse	Center width	Tolerated range
Pilot tone	32/44100 s	(25-47)/44100 s
Wide	26/44100 s	(20-40)/44100 s
Narrow	13/44100 s	(6-19)/44100 s
Sync	10/44100 s	(4-17)/44100 s

24.4.5 Loaders

This turbo system is integrated into various version of “Turbo operating system” (TOS) and also to one special version of TURBO BASIC XL widely used in former Czechoslovakia. Usual CIO device installed is T: or D:. CIO functions supported are OPEN, READ, WRITE and CLOSE.

24.5 Turbo Tape

24.5.1 Description

Advanced turbo system introduced with TT-DOS operating system sold by JRC company. Aim of this turbo system is to fully replace disk drive. Usual CIO device installed is B: or D:.

Four types of pulses are distinguished: Narrow pulse, wide pulse, pilot tone pulse and sync pulse. Bits are stored in MSB to LSB order.

File stored using Turbo Tape consists of blocks (BLOCK) that are 1026 bytes long. Every block is preceded by pilot tone (series of at least 256 pilot tone or wide pulses) which is followed by one sync or narrow pulse. Recommended number of pilot tone or wide pulses is at least 2000 in order to provide compatibility with available loaders.

24.5.2 Tape modes

Mode	Description
SS	Short gaps between blocks. First block is written twice, others once.
SD	Short gaps between blocks. All blocks are written twice.
LS	Long gaps between blocks. First block is written twice, others once.
LD	Long gaps between blocks. All blocks are written twice.

D modes provide data redundancy for safe data storage. First block is always written twice in order to provide convenient support for READ DIRECTORY CIO function.

24.5.3 Structure of the blocks

Offset	Description
0	Sequential number of the block. Numbering starts from 1. In case of D modes, pairs of blocks have same sequential number.
1	Tape mode: SS=128, LS=0, SD=192, LD=64
2,3	Bits 0-11: Offset of last valid byte in the block (16-1024), this offset will be denoted as B . Bit 15: Last block flag. Byte at offset 2: $B\%256$ Byte at offset 3: $[B/256] + [128 * (EOF\ is\ true)]$
4	Undefined number. All blocks of one file should have same number here.
5	Undefined.
6-16	File name and extension padded with spaces. First 8 bytes are devoted to file name, last 3 bytes are devoted to extension.
17-1024	Data itself (1008 bytes). Data must be padded with any bytes.
1025	Check sum = BLOCK[0] xor BLOCK[1] xor ... xor BLOCK[1025]

24.5.4 Timing

Timing is compatible with Turbo 2000 and Super Turbo.

24.6 B-TAPE

24.6.1 Description

Advanced turbo system introduced with B-TAPE extension for operating system BW-DOS. Aim of this extension is to fully replace disk drive. B-TAPE allows to use both CIO and SIO to exploit data recorder turbo modification. The disadvantage is a big size of the device handler. B-TAPE was designed as improvement of Turbo Tape system.

Four types of pulses are distinguished: Narrow pulse, wide pulse, pilot tone pulse and sync pulse. Bits are stored in MSB to LSB order.

File stored using B-TAPE consists of blocks (BLOCK) that are 1026 bytes long. Every block is preceded by pilot tone (series of at least 256 pilot tone or wide pulses) which is followed by one sync or narrow pulse.

Recommended number of pilot tone or wide pulses is at least 2000 in order to provide compatibility with available loaders.

24.6.2 Tape modes

Mode	Description
SS	Short gaps between blocks. First block is written twice, others once.
SD	Short gaps between blocks. All blocks are written twice.
LS	Long gaps between blocks. First block is written twice, others once.
LD	Long gaps between blocks. All blocks are written twice.

D modes provide data redundancy for safe data storage. First block is always written twice in order to provide convenient support for READ DIRECTORY CIO function.

24.6.3 Structure of the blocks

Offset	Description
0	Sequential number of the block. Numbering starts from 1. In case of D modes, pairs of blocks have same sequential number.
1	Tape mode: SS=128, LS=0, SD=192, LD=64
2,3	Bits 0-11: Offset of last valid byte in the block (16-1024), this offset will be denoted as B . Bit 15: Last block flag. Byte at offset 2: $B\%256$ Byte at offset 3: $[B/256] + [128 * (EOF\ is\ true)]$
4	Undefined number. All blocks of one file should have same number here.
5	Random number. All blocks of one file must have same number here. This random number allows to distinguish files with same file name.
6-16	File name and extension padded with spaces. First 8 bytes are devoted to file name, last 3 bytes are devoted for extension.
17-1024	Data itself (1008 bytes). Data must be padded with zeros if needed.
1025	Check sum = BLOCK[0] xor BLOCK[1] xor ... xor BLOCK[1025]

24.6.4 Timing

Timing is compatible with Turbo 2000 and Super Turbo.

24.6.5 Notes

B-TAPE device handler is able to read files stored using Turbo Tape system. In order to circumvent problems with big size of the device handler, special minimalistic binary loader called MICROB was shipped with B-TAPE.

25 Turbo systems from Poland

25.1 KSO Turbo 2000 and Turbo 2000F

25.1.1 Description

Turbo systems used in Poland, originally designed together with KSO Turbo 2000 (Tape operating system) and then adopted for other tape operating systems.

Three types of pulses are distinguished: Pilot tone pulse, wide pulse and narrow pulse. Bits are stored in MSB to LSB order.

File stored using KSO Turbo 2000 system consists of blocks. First block is a header block (HEADER), other blocks are data blocks (DATA).

Every block is preceded by pilot tone (series of pilot tone pulses).

Signal is expected on some pin of joystick port (KSO Turbo 2000) or on DATA-IN pin of the SIO connector (Turbo 2000F).

25.1.2 Header block

Offset	Description
0	Always 0
1	Always 255
2-11	File name (10 characters)
12	Check sum = (HEADER[0] + HEADER[1] + ... HEADER[11]) mod 256

25.1.3 Data block

Offset	Description
0-1	Number of valid bytes in the block, 0-3072.
2-3073	Up to 3072 bytes of data padded with zeros if needed.
3074	Check sum = (BLOCK[0] + ... + BLOCK[3073]) mod 256

File ends with data block that has less than 3072 valid bytes. If the total file size can be divided by 3072 without a remainder, file must end with block that has 0 valid bytes.

25.1.4 Timing

Pulse	Width
Pilot tone	44/44100 s
Wide	22/44100 s
Narrow	11/44100 s

25.2 Atari Super Turbo (AST)

25.2.1 Description

Turbo system used in Poland suitable for accommodation of binary files. Please note that the following information is incomplete.

Three types of pulses are distinguished: Wide pulse, narrow pulse and STOP pulse. Bits are stored in LSB to MSB order.

There are three main file formats: AST, BUT, and BOT. All three formats use blocks that have the following structure:

1. Pilot tone (narrow pulses)
2. Narrow pulse
3. Data (wide and narrow pulses)
4. Terminator 1 (4 narrow pulses)
5. Terminator 2 (128 STOP pulses)

25.2.2 AST File Format

This file format can be used to store binary files that have up to 44 segments and no INIT segments. File consists of several blocks.

1. Header block, 256 bytes of data
2. Data blocks. For each segment of the binary file, there is one data block.

25.2.3 BUT File Format

This file format can be used to store binary files. File consists of several blocks.

1. BUT loader header block. 6 bytes of data. It appears to be a boot header.
2. BUT loader data block. 576 bytes of data.
3. Pairs of data blocks for each segment. First block in a pair is a segment header, second block in a pair holds segment data.
4. Termination segment header¹

25.2.4 AST Header Block

Offset	Description
0	Number of segments (1-44)
1	Header check sum Check sum = (HEADER[2] xor HEADER[3] +xor... HEADER[255])
2-177	44 segment headers (start and end addresses)
178	Always 102
179	Always 85
180-199	File name. Internal code is used.
200	Always 0
201-244	Check sums for each segment block Check sum = (DATA[1] xor DATA[2] +xor... DATA[?])
245-255	Unknown. \$70, \$4b, \$00, \$d6, \$47, \$b4, \$cf, \$4b, \$00, \$d6, \$41.

25.2.5 BUT Loader Header Block

Offset	Description
0	Always 0
1	Length of the BUT loader data block in 128 bytes blocks. Always 5.
2,3	Loader load address. 1920.
4,5	Unknown. 182, 9.

25.2.6 BUT Loader Data Block

Offset	Description
0-575	BUT loader code

25.2.7 AST and BUT Data Block

Offset	Description
0-?	Data

25.2.8 BUT Termination Segment Header

Offset	Description
0-3	255, 255, 255, 255

¹TS is using slightly different format. There is no termination segment header, but the loader knows the number of segments.

25.2.9 Timing

Pulse	Width
Wide	22/44100 s
Narrow	12/44100 s
Stop	72/44100 s

25.3 Turbo Blizzard

25.3.1 Description

Turbo system used in Poland, suitable for accommodation of binary files (small blocks, high transfer speed). Three types of pulses are distinguished: Pilot tone pulse, wide pulse and narrow pulse. Bits are stored in MSB to LSB order.

File stored using Turbo Blizzard system consists of the following blocks.

1. Synchronization block. This block is preceded with pilot tone (3072 pilot tone pulses) and two narrow pulses. Block does not accommodate any data. Block is followed with silence lasting for 0.1 second.
2. Header block (HEADER). This block is preceded with pilot tone (302 pilot tone pulses) and two narrow pulses. Then 78 bytes of data follow. Block is followed with silence lasting for at least 3 seconds.
3. One or more data blocks. These blocks are preceded with pilot tone (302 pilot tone pulses) and two narrow pulses. Then 1029 bytes of data follow. Data blocks are separated by short gaps.

25.3.2 Header block

Offset	Description
0-75	File name
76	Check sum = (HEADER[0] + HEADER[1] + ... HEADER[75]) mod 256
77	Spare byte, always 0. This byte is never read by the loaders.

25.3.3 Data block

Offset	Description
0-1	Number of valid bytes in the block, 0-1024.
2-1025	Up to 1024 bytes of data padded with zeros if needed.
1026	Always 0
1027	Check sum = (HEADER[0] + HEADER[1] + ... HEADER[1026]) mod 256
1028	Spare byte, always 0. This byte is never read by the loaders.

25.3.4 Timing

Pulse	Width
Pilot tone	24/44100 s
Wide	12/44100 s
Narrow	8/44100 s

25.4 Turbo ROM

25.4.1 Description

Turbo system used in Poland, with limitations similar to Czechoslovak Turbo 2000 and Super Turbo Systems. This turbo system can accommodate Turbo ROM compatible binary files (these binary files consist of exactly one DATA segment at most one RUN segment and at most one INIT segment) or tokenized BASIC programs. Three types of pulses are distinguished: Wide pulse, narrow pulse and stop pulse. Bits are stored in LSB to MSB order.

File stored using Turbo ROM system consists of two blocks.

1. Header block (HEADER). This block is preceded with pilot tone (4884 wide pulses) and one narrow pulse. Then 41 bytes of data follow. After header block, there are four wide pulses and one stop pulse.
2. Data block. This block is preceded with pilot tone (516 wide pulses) and one narrow pulse. Then data follow. Data blocks are separated by short gaps. After data block, there are four wide pulses and one stop pulse.

25.4.2 Header Block for Binary Files

Offset	Description
0	Header block check sum = (HEADER[1] ... xor ... HEADER[40])
1-2	Header load address (1537)
3-4	Header length excluding first byte (40)
5	Data block check sum = (DATA[0] xor DATA[1] xor ... DATA[?])
6-7	RUN address
8-9	INIT address
10-11	Load address
12-13	Data block length
14	Padding 0
15-34	File name. Internal code is used.
35	Program type flag. For binary files there is 1.
36	0 - JSR to the INIT address, 1 - No JSR to the INIT address
37-39	Padding zeros
40	RTS opcode (96)

25.4.3 Data Block for Binary Files

Offset	Description
0-?	Data bytes

25.4.4 Header block for BASIC files

A BASIC file consist of two parts. A header part (14 bytes long) and a main part. Data from the header part is stored in the header block and data from the main part is stored in the data block. The tokenized form of the BASIC file is relocatable and can be loaded to any address. Such address is denoted as base address.

Offset	Description
0	Header block check sum = (HEADER[1] ... xor ... HEADER[77])
1-2	Header load address (1537)
3-4	Header length excluding first byte (77)
5	Data block check sum = (DATA[0] xor DATA[1] xor ... DATA[?])
6-7	RUN address (41086). Points to a routine in the BASIC ROM.
8-9	INIT address. Always 0 for a BASIC program.
10-11	LOAD address. Calculated as base address + VNT.
12-13	Data block length. Length of the main part of the BASIC file.
14	Padding 0
15-34	File name. Internal code is used.
35	Program type flag. Always 0 for a BASIC program.
36	1 - No JSR to the INIT address
37-39	Padding zeros
40-59	Routine that copies the header part to the zero page 0xA2, 0x11, 0xBD, 0x3C, 0x06, 0x95, 0x80, 0xCA, 0x10, 0xF8, 0x60
60	Header part of the BASIC file (LOMEM, VNT, VNTE, VVT, STMTAB, STMCUR, STARP)
74-75	Address right past the loaded BASIC file (LOAD address + length of the main part)
76-77	Address right past the loaded BASIC file (LOAD address + length of the main part)

25.4.5 Data Block for BASIC Files

Offset	Description
0-?	Main part of the BASIC file

25.4.6 Timing

Pulse	Width
Wide	16/44100 s
Narrow	6/44100 s
Stop	48/44100 s

25.5 Hard Turbo

25.5.1 Description

Turbo system used in Poland that can accommodate only binary files.

Three types of pulses are distinguished: Pilot tone pulse, wide pulse, and narrow pulse. Bits are stored in MSB to LSB order.

File stored using Hard Turbo system consists of many blocks. There are three types of blocks.

1. Main header block (HEADER). This block is preceded with pilot tone (at least 512 pilot tone pulses) and one narrow pulse. Then 41 bytes of data follow.
2. Segment header block (SEGHEAD). This block is preceded with pilot tone (at least 512 pilot tone pulses) and one narrow pulse. Then 6 bytes of data follow.
3. Segment data block (DATA). This block is preceded with pilot tone (at least 512 pilot tone pulses) and one narrow pulse. Then data bytes follow.

A Hard Turbo file starts with the main header block. Then pairs of segment header and segment data blocks follow. The file ends with one special segment header block.

25.5.2 Main Header Block

Offset	Description
0	Identification byte, always 0
1-39	File name. ATASCII string terminated with EOL (155)
40	Check sum = (HEADER[0] xor HEADER[1] xor ... HEADER[39])

25.5.3 Segment Header Block

Offset	Description
0	Identification byte, always 255
1,2	First address of the following segment. Value of 65535 (255 255) indicates end of file
3,4	Last address of the following segment (increased by one)
5	Check sum = (SEGHEAD[0] xor SEGHEAD[1] xor ... SEGHEAD[4])

25.5.4 Segment Data Block

Offset	Description
0	Identification byte, always 255
1-?	Segment data
Last	Check sum = (DATA[0] xor DATA[1] xor ... DATA[?])

25.5.5 Timing

Pulse	Width
Pilot	34/44100 s
Wide	22/44100 s
Narrow	12/44100 s

25.6 Lower Silesia Turbo 2000

25.6.1 Description

This turbo system appears to be very similar to Turbo 2000 from former Czechoslovakia.

Four types of pulses are distinguished: Narrow pulse, wide pulse, pilot tone pulse and sync pulse. Bits are stored in MSB to LSB order.

There are several file formats used.

25.6.2 Auto Turbo Format

This format is used to store binary files with limitations. Binary files without INIT segments can be stored and executed. Binary files with INIT segments can be stored, but not executed.

File stored using Auto Turbo format consists of two blocks - header block (HEADER) and data block (DATA). Both blocks are preceded by pilot tone (series of at least 256 pilot tone pulses) which is followed by a sync pulse (which is very narrow pulse). Recommended number of pilot tone pulses is at least 2000.

25.6.3 Unknown Exterminator Unprotected Binary Format and Protected Binary Format (UE UBF and UE PBF)

These file formats can be used to store binary files. A binary loader is prepended before the file. File consists of several blocks.

1. Dummy RUN block. 2 bytes of data (UE PBF only).
2. Pairs of data blocks for each segment. First block in a pair is a segment header (SEGHEAD), second block in a pair holds segment data (SEGDATA).
3. Termination segment header

25.6.4 Auto Turbo Header block

Offset	Description
0	Always 0
1	File type. Always 4.
2-11	File name
12-13	Always 0
14-15	Length of file
16-17	Always 0
18	Check sum = (HEADER[0]) xor ... xor (HEADER[17])

25.6.5 Auto Turbo Data block

Offset	Description
0	Always 255
1-?	Data of the binary file (includes segment headers)
Last	Check sum = (DATA[0] xor ... xor DATA[?])

25.6.6 UE PBF Dummy RUN block

Offset	Description
0,1	0x02 0xE0
2	Check sum = 0xE2

25.6.7 UE UBF and UE PBF Segment Header Block

Offset	Description
0,1	First address of the following segment
2,3	Last address of the following segment
4	Check sum = (SEGHEAD[0] xor ... xor SEGHEAD[3])

25.6.8 UE UBF and UE PBF Segment Data Block

Offset	Description
0-?	Data
Last	Check sum = (SEGDATA[0] xor ... xor SEGDATA[?])

25.6.9 UE UBF and UE PBF Termination Segment Header

Offset	Description
0-3	0x00,0x00,0x00,0x00
4	Check sum = 0x00

25.6.10 Timing

Standard transfer speed is approximately 2270 bauds. There is a big tolerance for width of all pulses.

Pulse	Center width	Tolerated range
Pilot tone	32/44100 s	(25-47)/44100 s
Wide	26/44100 s	(20-40)/44100 s
Narrow	13/44100 s	(6-19)/44100 s
Sync	10/44100 s	(4-17)/44100 s