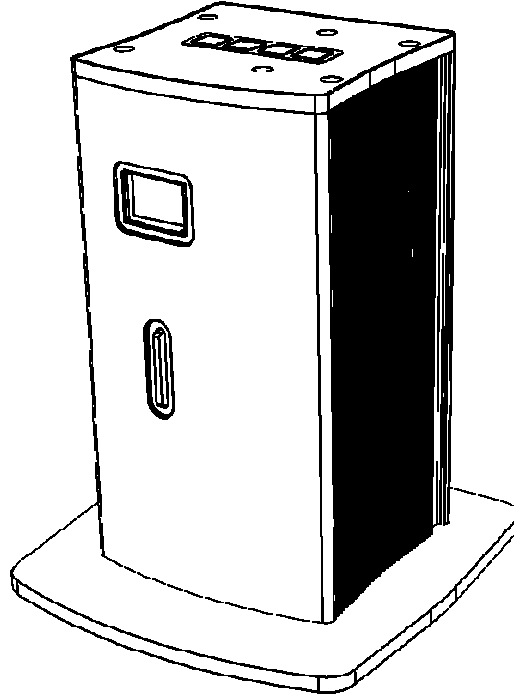


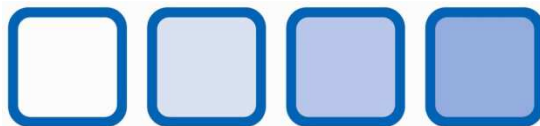
AudioFile User Guide

Version 1.0 September 2012



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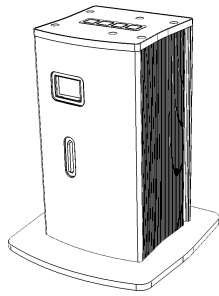
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| Version | Date | Changed by: | Description of Changes |
|----------------|-------------|--------------------|-------------------------------|
| 1.0 | 20/9/2012 | E.Wallington | First issue |
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Parts List



AudioFile – triggerable audio stimulus generator.

SDcard – holds settings and audio files.

Put this in the SDcard socket on the front of Audiofile.



USB cable – connects from AudioFile to the host computer.

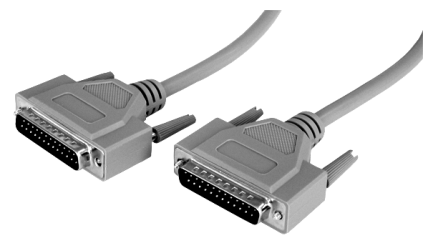
Instructions – printed version of these instructions.

Optional items



BNC trigger cable – connects from AudioFile to the visual stimulus generator system.

25 way track code cable – connects from AudioFile to the visual stimulus generator system.



Toslink digital audio (fibre optic cable) – connects from Audiofile to an external amplifier or amplified headphone system.

Analogue audio lead (various types) – connects from Audiofile to an external amplifier or amplified headphone system. The lead must finish in a stereo 3.5mm jack plug to fit Audiofile. The other end can be another jack plug (3.5mm or ¼ inch), or a pair of phono plugs, depending on the amplifier connections.

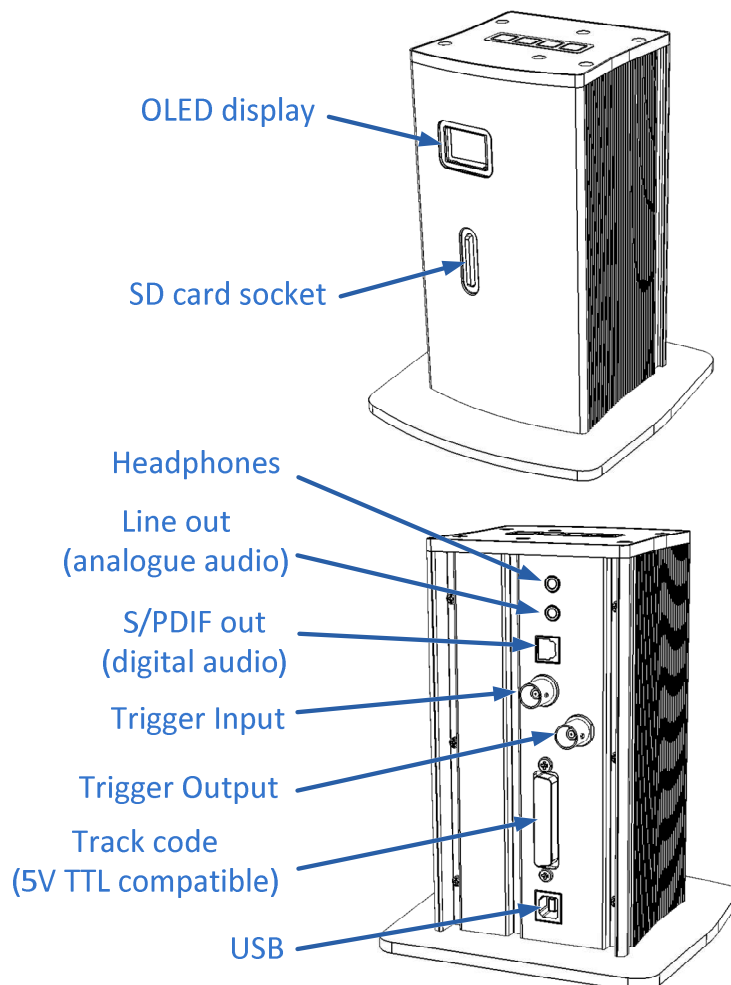
Introduction

Features

AudioFile is a zero latency triggerable audio stimulus generator (ASG).

- A colour OLED display shows status information.
- It has a slot for a SDcard for stimulus track storage. The files are stored as uncompressed 16 bit 44kHz wav files to avoid introducing audio artefacts. A 2GB card is supplied with AudioFile which gives over 3 hours of recorded stimulus.
- It is triggered with a TTL pulse, typically from a Visual Stimulus Generator (like the Cambridge Research Systems Visage or Bits#). A parallel digital code is also presented, which controls which stimulus track is to be played.
- A trigger output indicates when a track is playing.
- Audio output is via an optical SPDIF output, or conventional analogue line out.
- A separate headphone output is provided.
- USB bus powered, no separate PSU required.

Ports and connectors



Application

AudioFile can be used with the Cambridge Research Systems Visage or Bits# systems to provide a complete audio / visual stimulation solution. It is also capable of being used with any other visual stimulus generator that can create the necessary trigger pulses.

AudioFile is a self-contained system, it frees the experimenter from concerns about latency in generating the stimulus (which plague software only solutions).

When coupled with a MRI compatible audio delivery system it becomes part of a total MRI solution including the BOLDscreen range of MRI compatible displays.

Setting up the control Computer

USB interfaces

The USB connection is configurable, and provides two different interfaces to the host computer over the single USB lead. It is compatible with all major operating systems.

- 1) Mass storage interface. This can be used to load the stimulus tracks on to AudioFile, configuration changes and firmware updates. This interface is accessible when in *AUDIOFile* mode only.
- 2) USB audio class device. For compatibility with some audio stimulus generation software, AudioFile can also be used as a standard audio output device. When in this legacy mode, latency does depend on the host operating system and drivers. The *USB Audio* mode does not expose the mass storage interface. To leave this mode the SDcard needs to be removed and placed into a card reader.

Configuring AudioFile and interfaces

Audiofile is shipped with the mass storage interface active (AUDIOFile mode). Start by plugging in the USB lead from the Audiofile to the host computer. The contents of the SD card will then appear as another volume called "*Audiofile*" (Audiofile acts as a SD card reader in this mode).

If you want to change to USB Audio mode, edit the **config.xml** file located on the Audiofile volume. You can edit this file with any suitable text editor (for instance Notepad on Windows, or TextEdit on OSX). Typical contents as follows:

```
<?xml version="1.0"?>
<AUDIOFILE_CONFIG>
#DeviceType Is Either "AUDIOFile" Or "USB Audio"
    <Entry DeviceType="AUDIOFile"/>
</AUDIOFILE_CONFIG>
```

Edit the entry called DeviceType to read "AUDIOFile" or "USB Audio" as desired.

Once you have finished editing the Config.xml file, exit the text editor (saving the file when prompted). Then re-boot the LiveTrack box by disconnecting the USB lead, waiting for 2 seconds, then reconnecting it.

Laptop computers

With a laptop computer, you may receive a message that there is insufficient power available. AudioFile requires 500mA to be available from the USB connection. In this case try (in this order):

1. A different USB socket on the laptop.
2. Connecting the laptop to its mains charger.
3. Or finally connect LiveTrack by a powered USB hub.

Maintenance

Performing firmware updates

Firmware updates are easily performed by creating a subdirectory called *Firmware* on the SD card, and copying the firmware update file to that directory. Once the copy has been completed, restart the Audiofile by disconnecting then reconnecting the USB lead.

Setting up the audio stimulus

Playlist XML file

The file **Playlist.xml** contains the details of how the code on the parallel connector, maps to the file names of the wav files that are to be played. You can edit the file with any text editor. Typical contents as follows:

```
<?xml version="1.0"?>
<AUDIOFILE_PLAYLIST>
  <PLAYLIST1>
    <Entry Folder="Feels like Home, Norah Jones\Audio"/>
    <Entry Track="01 - Sunrise.wav"/>
    <Entry Track="02 - What Am I To You.wav"/>
    <Entry Track="03 - Those Sweet Words.wav"/>
    <Entry Track="04 - Carnival Town.wav"/>
    <Entry Track="05 - In the Morning.wav"/>
    <Entry Track="06 - Be here to Love Me.wav"/>
    <Entry Track="07 - Creepin' In.wav"/>
    <Entry Track="08 - Toes.wav"/>
    <Entry Track="09 - Humble me.wav"/>
    <Entry Track="10 - Above Ground.wav"/>
    <Entry Track="11 - The Long Way Home.wav"/>
    <Entry Track="12 - The Prettiest Thing.wav"/>
    <Entry Track="13 - Don't Miss You at All.wav"/>
  </PLAYLIST1>
  <SYSTEM>
    <Entry UseDigitalInputD0="FALSE"/>
    <Entry Volume="75"/>
  </SYSTEM>
</AUDIOFILE_PLAYLIST>
```

Note 1: The entry **UseDigitalInputD0** controls whether input bit 0 is used or not. For compatibility with VSG Visage systems, D0 is normally disabled and bits D1 to D7 are the code (128 values). If **UseDigitalInputD0** is set true then 256 code values can be used.

Note 2: The code value of zero (00h, '000 0000'), is a special code which stops the current track from playing.

Note 3: The code of all lines high (127 in decimal, 7Fh, '111 1111'), is a special code that causes all tracks to be played in their entirety and in the sequence as determined by the **Playlist.xml** file.

Note 4: The volume setting controls the headphone analogue output only.

Loading the stimulus tracks

The user is free to create whatever directory structure necessary to hold the stimulus wav files. It is recommended that they are *not* located in the root of the Audiofile volume, create subdirectories for them.

Please note that only the name of the wav file can be specified in the **Playlist.xml** file, therefore all files should have unique names.

Connecting the audio output

Connecting headphones

Any suitable pair of headphones can be plugged in to the headphone socket.

Connecting an external amplifier (for headphones or speakers)

An external amplifier can be connected to the digital or line level analogue outputs of Audiofile as appropriate.

Considerations for Phase shift (delay) of audio signals.

The digital audio output of Audiofile has no significant phase shift compared to the trigger signal (< 100us). Subsequent conversion to analogue signals can however result in

significant extra latency, depending on the technology used in the external digital to analogue converter (DAC).

Typically audio DAC's use sigma-delta type technology which by design introduces a delay to the audio signals. Professional audio equipment often has lower latency; alternatively if the external latency can be determined from the equipment specifications, then the stimulus can be constructed to compensate for the external latency.

Triggering the audio output

Trigger Input BNC

This 5V TTL compatible line should be taken high to start playing the track. If you are using a Cambridge Research Systems "Bits#" or "Visage" visual stimulator, then connect the Audiofile trigger input to the "Trig out" BNC on the back of the Bits# or Visage tower.

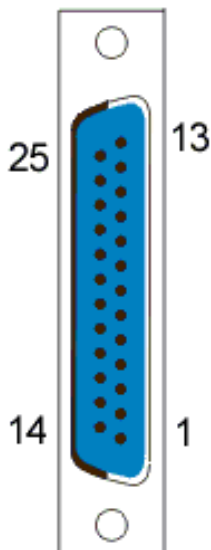
Alternatively the connection is also available on the 25 way connector.

Trigger Output BNC

This 5V TTL compatible output goes high when audio data is being output. If you are using a Cambridge Research Systems "Bits#" or "Visage" visual stimulator, then you can connect the Audiofile trigger input to the "Trig in" BNC on the back of the Bits# or Visage tower if you wish to monitor when audio is being output.

Alternatively the connection is also available on the 25 way connector.

Parallel track code connector



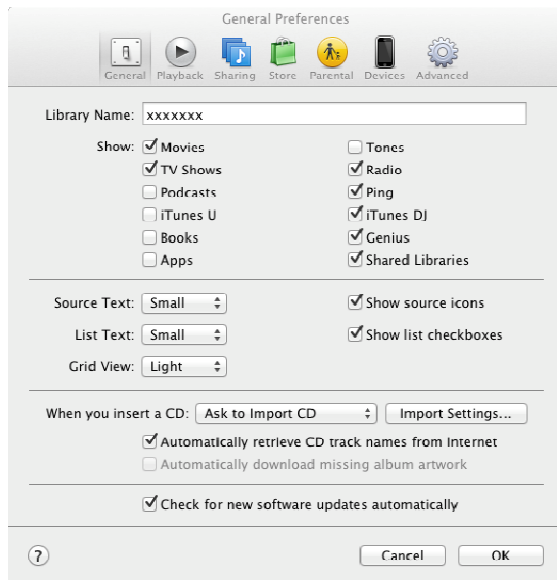
The pinout of this connector is designed to match a Cambridge Research Systems "Visage" or "Bits#" digital i/o connector. Therefore a cable with male 25 way D type connectors that routes straight through all connections is suitable.

| Pin number | Function |
|------------|---------------|
| 1 | Dout0 |
| 2 | Dout1 |
| 3 | Dout2 |
| 4 | Dout3 |
| 5 | Dout4 |
| 6 | Dout5 |
| 7 | Dout6 |
| 8 | Dout7 |
| 9 | Trigger In |
| 10 | 0V |
| 11 | No connection |
| 12 | 0V |
| 13 | 0V |
| 14 | reserved |
| 15 | reserved |
| 16 | reserved |
| 17 | reserved |
| 18 | reserved |
| 19 | reserved |
| 20 | reserved |
| 21 | reserved |
| 22 | No connection |
| 23 | No connection |
| 24 | Trigger Out |
| 25 | reserved |

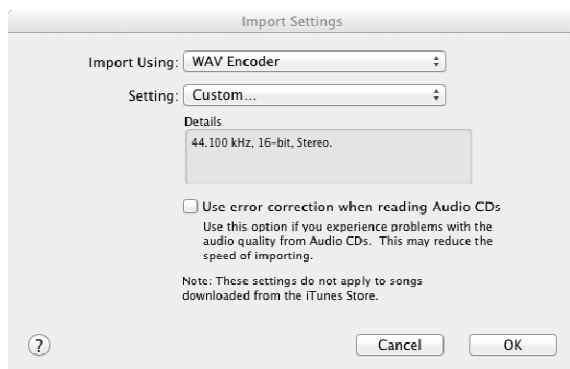
Generating the stimulus files

Using iTunes

iTunes can create wav files from any unprotected file in the iTunes library. It can also create wav files from direct from an audio CD. By default iTunes uses the compressed AAC encoder. To enable the wav encoder instead you need to change the “Import Settings”. These are located in the “General Preferences” (shown here under OSX 10.7)

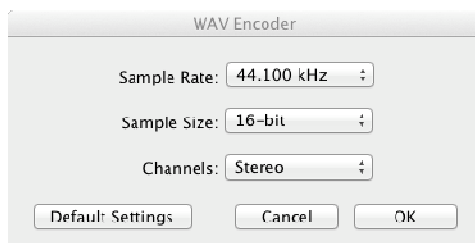


Click the “Import Settings” button.



Then change the “Import Using” drop down to “WAV encoder”.

Then go to the Setting drop down and select “Custom...”



In this window select 44.1kHz, 16-bit and Stereo.

Using MATLAB

MATLAB can read and write wav files using the *wavread* and *wavwrite* functions.

When writing files set the sample rate to 44100 Hz thus:

```
wavwrite(variable_name, 44100, filename);
```

When reading files, make sure they are recorded with a sample rate of 44100Hz.

```
Variable_name = wavread(filename);
```

Safety

Life support applications



Audiofile should NOT be used in situations where failure of the device would constitute a hazard. It is designed for research applications only, and like any other regular electronic device could fail at any time, without warning.

Magnetic fields



Audiofile is MR unsafe. Do not take Audiofile or any of its leads into the magnet room of an MRI scanner.

Cleaning



Clean external components of LiveTrack with a damp cloth only. Do NOT allow fluids to enter any of the LiveTrack components. Do not sterilise in an autoclave.

Servicing



DO NOT ATTEMPT TO DISMANTLE Audiofile. It contains no user serviceable components, refer all servicing to Cambridge Research Systems.

Contact

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