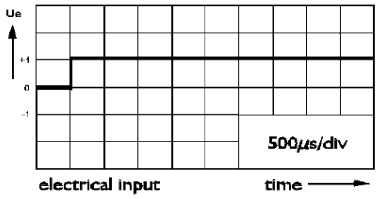
Frequency/Time domain comparison of 2-way Abbey and a DSP loudspeaker

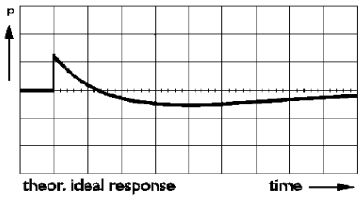
Notice: **All relevant data shown in this paper was recovered from file "Abbey30.txt" posted by Dr Earl Geddes on http://www.diyaudio.com/forums/multi-way/103872-geddes-waveguides-575.html - post N# 5744 and file "Abbey30_ir.txt" posted in post N# 5747, on 19 and 20 March 2013.**

1. Step Response

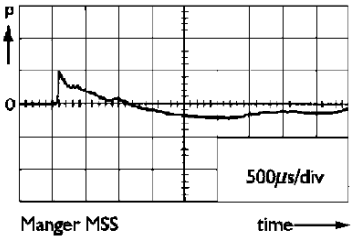
First – some background, graphical information on step responses from the following source: http://www.manger-audio.co.uk/PDFs/acoustical_reality.pdf

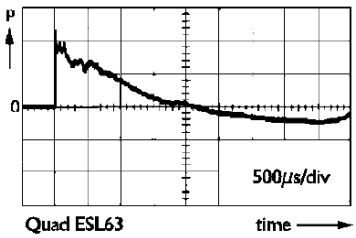


electrical input



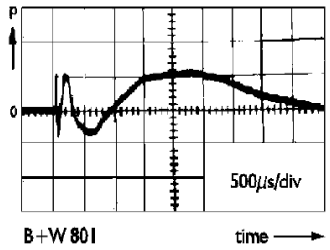
theoretical ideal presuure
step response in air

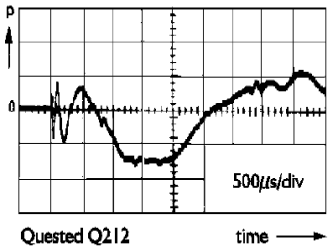


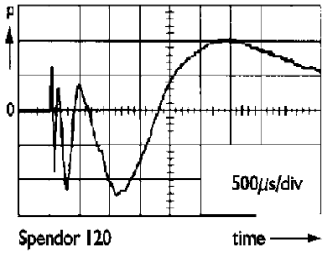


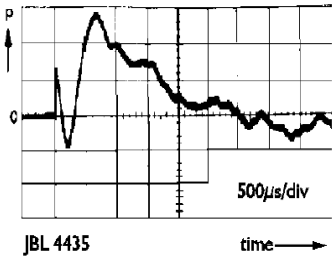
closed to the ideal

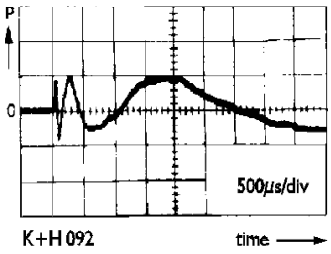
In contrast - some examples of other loudspeakers (from the same source).

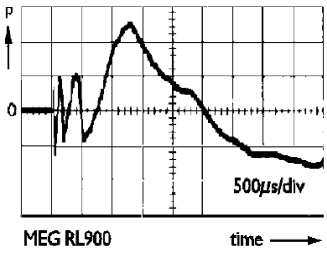




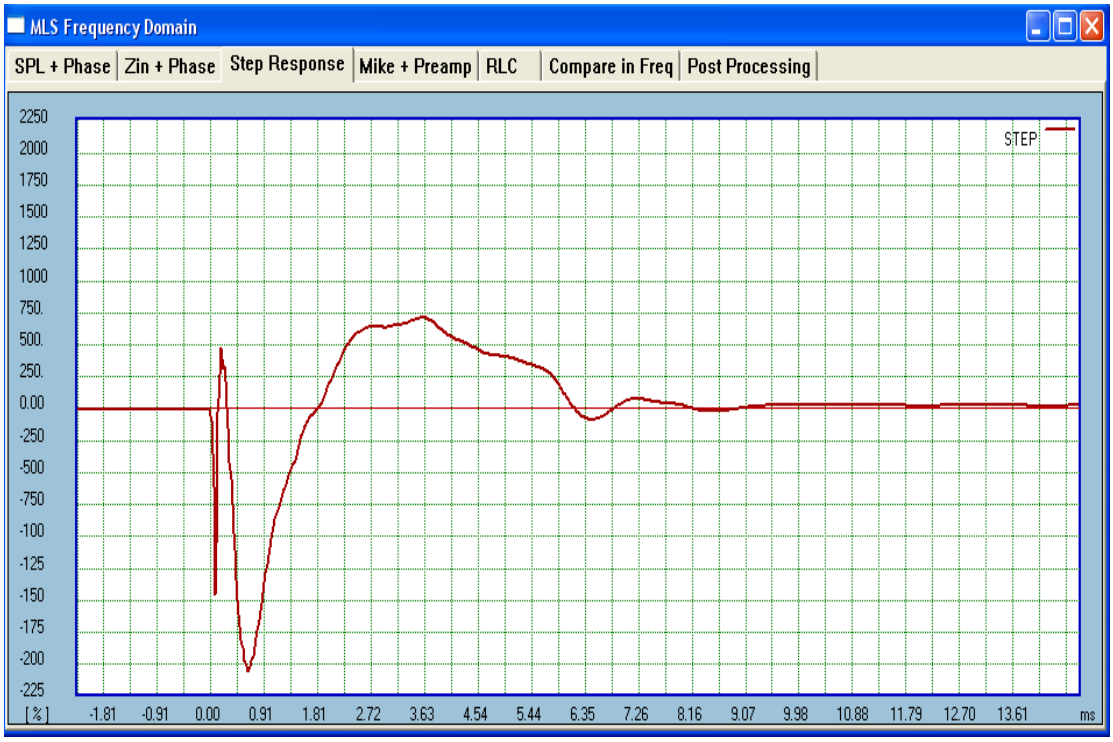




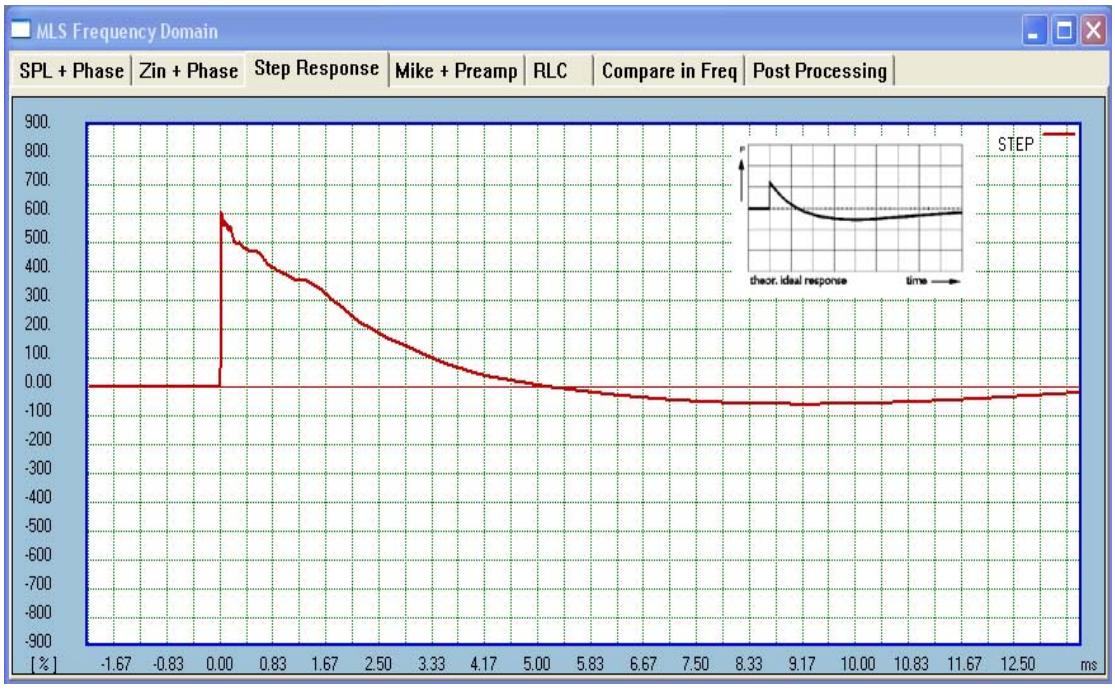




Step Responses of typical loudspeakers



2-way Abbey's Step Response. Maximum output occurs at around 0.60ms after the pulse was applied. Published frequency response of Abbey loudspeaker is shown on the last page of this paper.

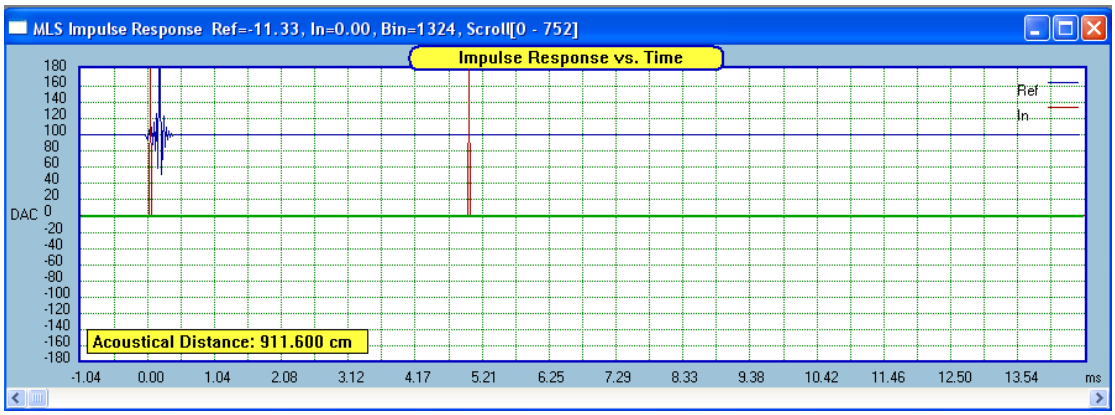


For comparison - Step Response of DSP equalized loudspeaker. Frequency response of this 2-way loudspeaker is also shown on the last page.

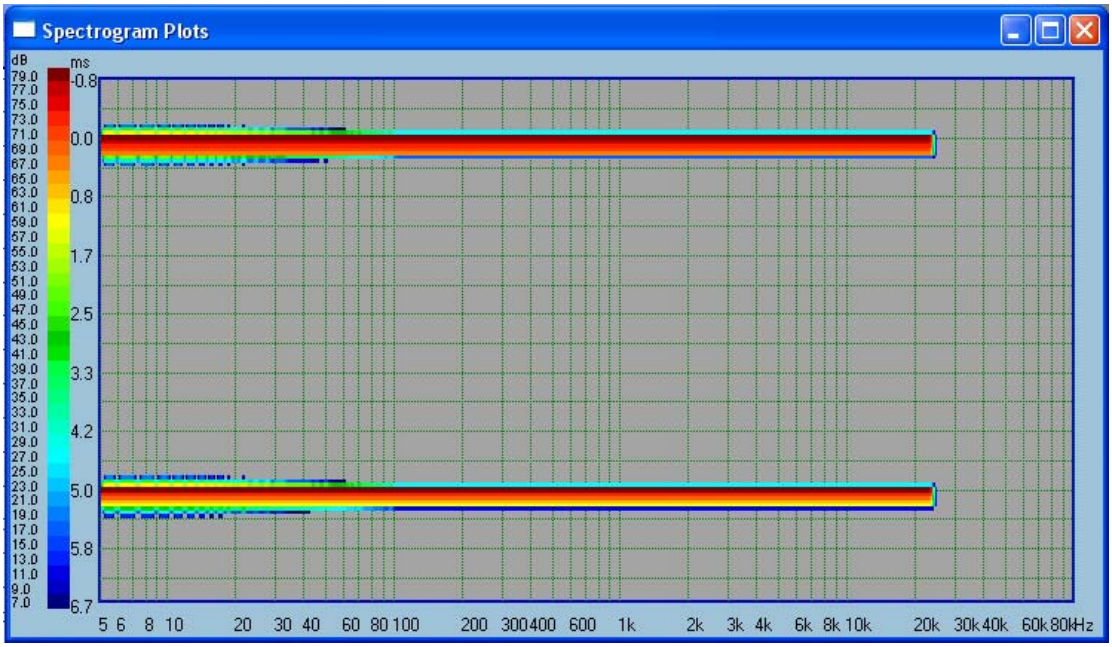
2. Spectrograms

Several methods exist for calculating spectrograms, including the windowed FFT method (WFT), and the wavelet transform. Example below employs the windowed FFT method and produces a spectrogram by applying a data window to the impulse response and computing the FFT of the windowed data. The window is progressively shifted in time to obtain a frequency response for each discrete time.

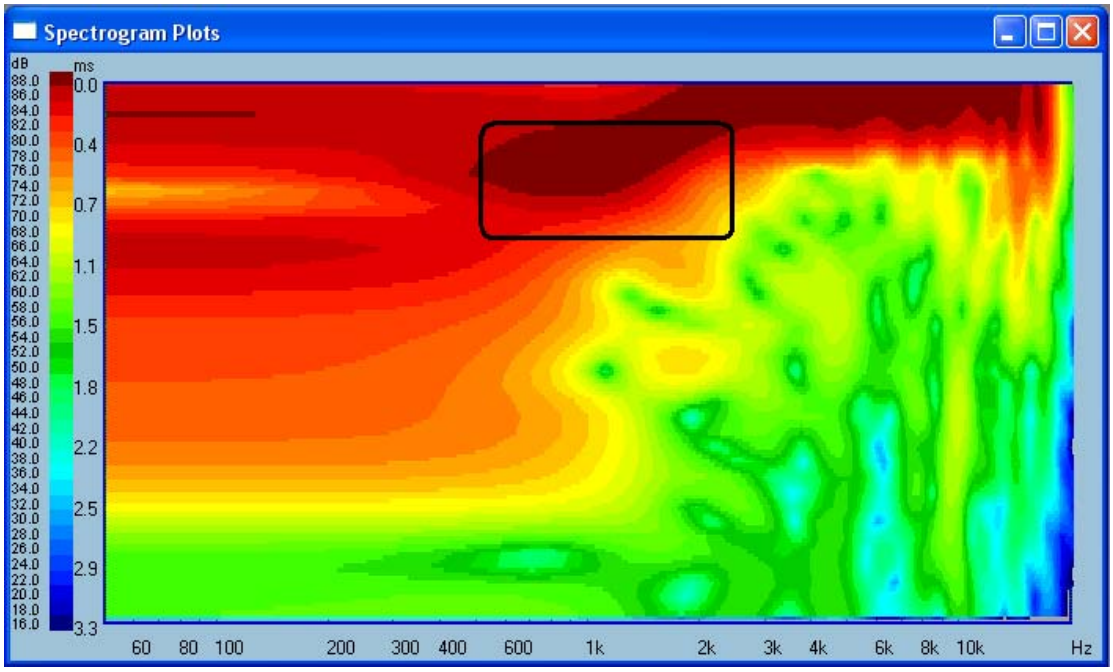
In the example below, there two “ideal” impulse responses, separated by 5ms, fed into the Spectrogram function.



Two ideal impulse responses (red), separated by approximately 5ms.



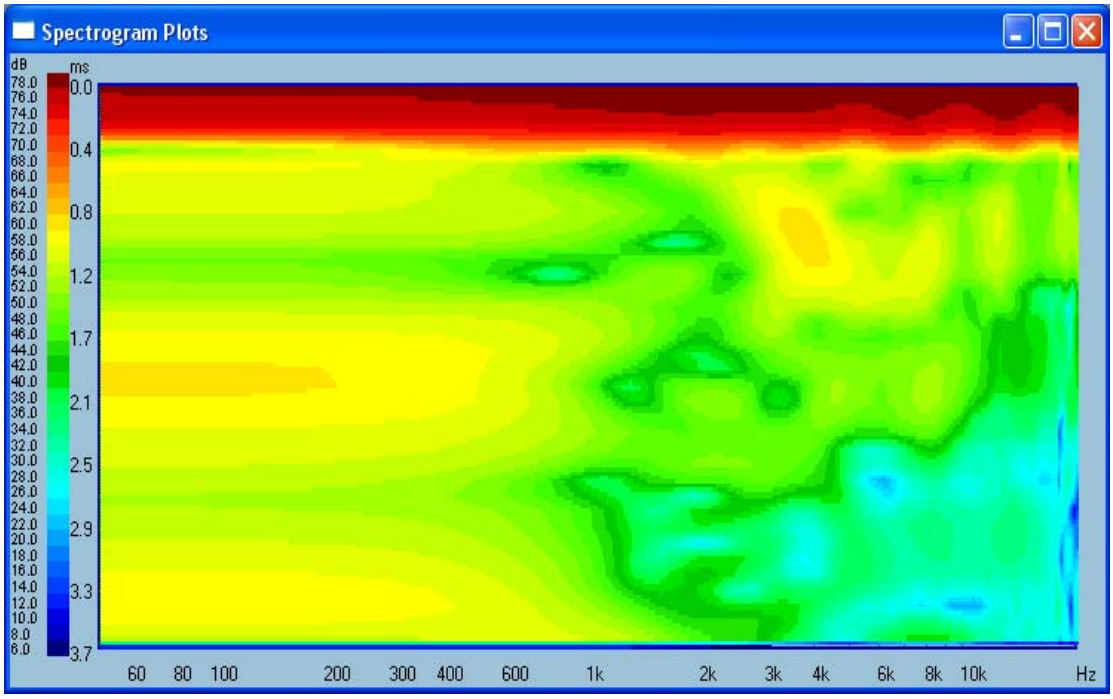
Spectrogram of the two impulse responses.



Spectrogram of Abbey loudspeaker

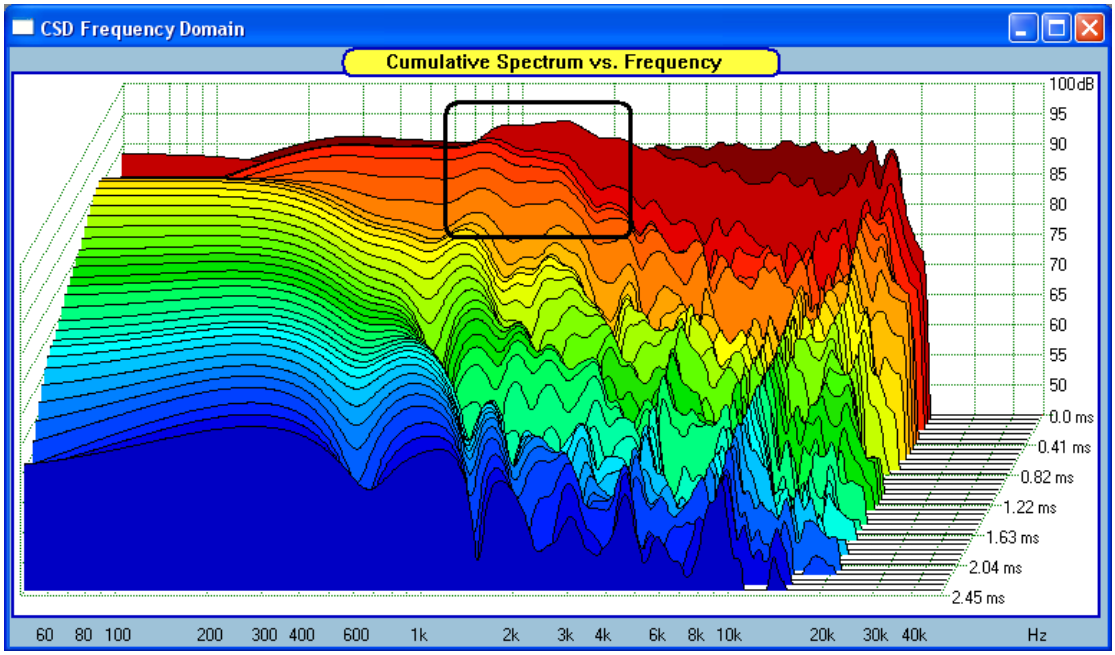
The black rectangle shows strong output between 600-2000Hz at around 0.60ms.

Accordingly to http://www.diyaudio.com/forums/multi-way/103872-geddes-waveguides-577.html post N# 5762 - Crossover is at 900Hz.



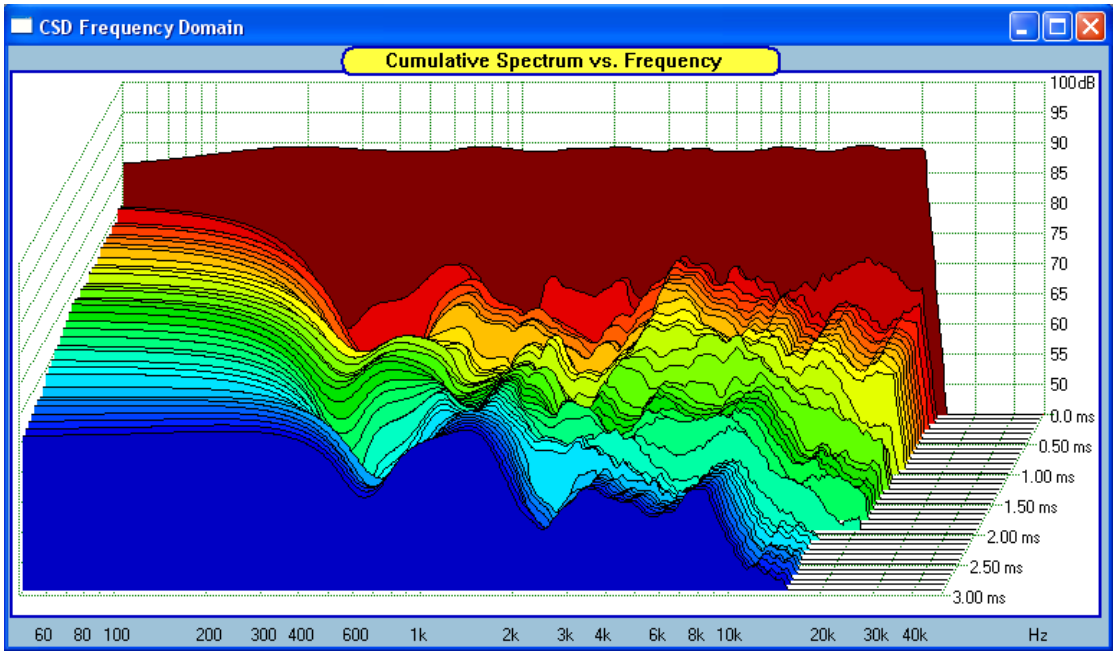
For comparison - spectrogram of a DSP equalized, 2-way loudspeaker.

3. Cumulative Spectrum Decay (CSD).



CSD of Abbey - 2-way waveguide loudspeaker.

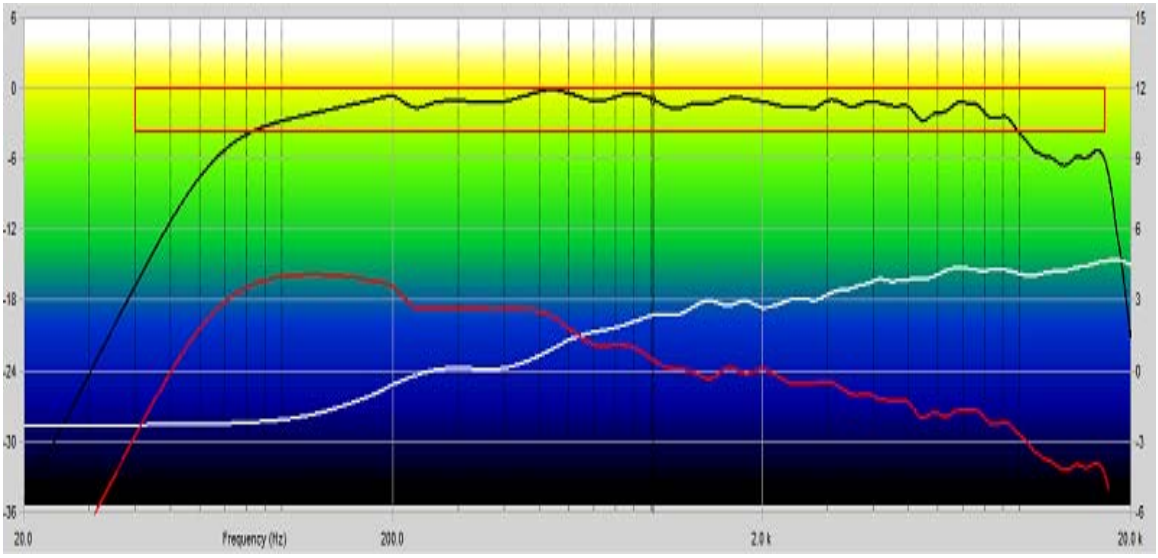
In the highlighted area (black rectangle) a group of CSD waterfalls exhibit elevated amplitude, and produce a output around 600-2kHz range up to 0.60ms. The ridge around 17-18kHz quite noticeable. The (2.5/f) transient fidelity AESTD1001.1.01-10 requirement calls for -8.64dB drop immediately at 0.147ms at 17kHz. It's a "border-line" case here?.



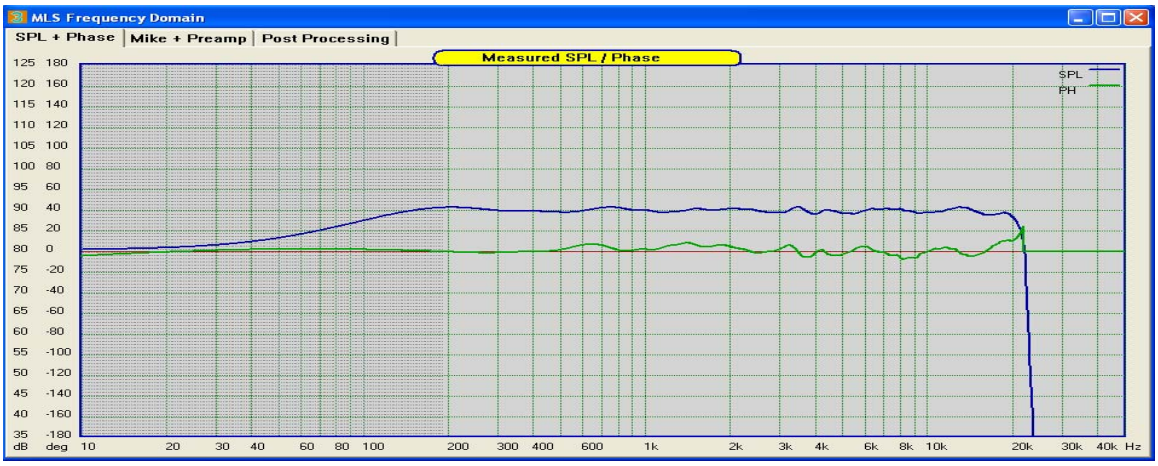
For comparison - two-way loudspeaker (12dB/oct LR @ 2kHz) with DSP EQ.

4. Frequency Response

Source: http://www.gedlee.com/abbey.htm



Frequency Response of Abbey – red rectangle shows recommended SPL tolerance for Hi-Fi loudspeakers, as per AESTD1001.1.01-10.



Frequency/Phase Response example of DSP equalized 2-way loudspeaker

Frequency/Phase Response example of DSP equalized subwoofer