

Advice for Mastering and Authoring DVD-Audio content

Scope

This note is addressed to content creators and to companies providing equipment or software for mastering or authoring content for release on DVD-Audio. It supplements the important guidelines proposed by Nippon Columbia Ltd. [1]

Context

DVD-Audio supports sampling rates between 88.2kHz and 192kHz and is capable of delivering audio above 20kHz. To date, audio equipment designers have normally accepted 20kHz as an upper design limit – and indeed, even the exceptional human listener cannot normally detect continuous tones for frequencies much above 25kHz.¹

By providing a carrier that can deliver a full power signal in the supersonic region we risk unfortunate consequences as highlighted in [1].

For this note ‘supersonic’ is defined to be the ranges 22kHz to 48kHz (for 96kHz sampling) and 22kHz to 96kHz (for 192kHz sampling), 22kHz being chosen because of the implicit limit of CD.

Normal audio – for example if measured at a live performance – can contain supersonic elements but these are neither sustained nor at consistently high levels.

Perceived Risk

For the past generation, audio equipment has been designed either with a 20kHz performance limit in mind, or developed with this implied assumption. For example, the implied assumption can be that millions of playback systems are in everyday use which, because of the power bandwidth of vinyl source and the brick-wall limit of CD, cassette or FM sources, have not been evaluated for security or safety when driven with substantial levels of supersonic signals.

The following list illustrates a partial list of playback system vulnerabilities:

1. Power handling capacity of tweeters or super-tweeters
2. Power handling capacity of passive components in loudspeaker crossover networks
3. Overheating of power amplifier output stages when driven at supersonic frequencies
4. Power handling capacity of power amplifier output stabilisation (Zobel) networks.

As an example, loudspeaker and amplifier designs exist where 1, 2 or 4 could be at risk for signal levels as low as 1W when averaged with a time-constant of a few seconds. Since 1W could result from a signal at –20dBFS in a nominal 100W system, we can imagine that continuous supersonic signals substantially below full scale should be considered ‘at risk’ to deteriorate either playback equipment or to cause unnecessary overheating.²

Inadvertent Content

Nippon Columbia has quite correctly pointed out in [1] that warnings should be attached to test signals containing significant supersonic content.

We recommend that some precautions be introduced in mastering and authoring to prevent the release of otherwise normal audio content that inadvertently contains excessive supersonic energy.

The following possible sources are cited as real and potential examples:

- Excessive noise shaping in signal processing or conversion
- High energy in aliased content due to upsampling without adequate filtering
- Equipment or hook-up faults leading to electronic oscillations in the supersonic region
- Supersonic output from new generation high-rate synthesisers and similar musical instruments

¹ Of course, leading to the adoption of higher sampling rates, it has been widely accepted that higher sampling rates than the minimum of 48kHz provide audible benefit. This is probably due to improved time resolution and/or the reduction of various effects at the band edge from anti-alias or anti-image digital filters and/or aliasing effects.

² It would be useful for members of WG-4 to provide data on these and other limiting items

It is imagined that not all mastering systems will reliably indicate levels for signals between 20kHz and 100kHz and may well underestimate in this region. It is easy to imagine that supersonic 'whistles' could fail to be observed by a listener or a level meter and pass to disc production.

Recommendation

It is suggested that equipment used for content processing be designed or modified so that excessive supersonic energy can be automatically detected.

In the short term some risk can be removed by ensuring that level meters indicate accurately to 100kHz or by performing spectrum analysis.

For new and upgraded designs we recommend adding a monitoring process that causes a warning to be issued based on supersonic content.

Obviously there are many methods for estimating this content. As an initial simple offering, averaging the signal power above 22kHz with a time-constant of 1 second and raising a flag above -20dBFS should be adequate.

The obvious place for this to be done is at the final mastering stage, or in an encoder.

Reference

[1] Nippon Columbia Ltd, 'Advice to DVD-Audio software and hardware manufacturers'